POWER

Vol. 47 NEW YORK, JUNE 11, 1918 No. 24

Success—On Things in General, Personal and Otherwise

"I would like to study, but haven't the time." This is a familiar complaint. But consider the man who always has some educational literature with him, reading at spare moments, waiting for his dinner order, on train, trolley or ferry, homeward bound. Many possible moments exist for all of us; like the pennies, in the end they count and should be saved. One's time has a cash value.

Do you ridicule the man who studies up, saying "Work can be learned only by contact"? When he attains that position which you had thought to be yours simply by virtue of long service, do you complain and berate your luck? The man too valuable to longer occupy the lower position is given the one ahead; though not working at it, still he had acquired by study the fundamentals of the undertaking. He who does not progress surely goes backward.

Think not of the pleasures others have during social hours while yours is only study. Endurance wins. In games of skill a fair degree of proficiency is to be admired; beyond that, it is a waste of time, and no one cares to play with a professional.

Do not let personalities interfere with your progress. But some other fellow may. Study your own to avoid friction; no one advances on merit alone. Personality and temper control are gained by the preservation of health. One should not study to the detriment of health, but maintain that course compatible with progress which conserves the health necessary to enjoy the fruits of labor.

Money is not always a measure of success. Reasons of existence give each his part in the world's undertakings. Though you only have a ditch to dig and dig it well, success is yours; dig it better and a goal is defined for the other man. Branch out with success and extend it to all things, even to your leisure moments.

Is it impossible to advance? Are there necessary restrictions or limitations beyond which you may not go? This is your individual problem. Nothing is perfect; never complain; strive to make right, that is the purpose of your existence. Work cheerfully or choose an environment suited to your temperament; someone specially fitted may win in the place you vacate.

A fair appearance consistent with your position is commendable. Harmony, with utility in design, sells goods, so your good appearance impresses others, commanding respect and results.

You save for your employer a small amount and lift your head with pride, little realizing that your salary is his investment—you the instrument of service to economize for him. Equal results could be obtained by others; your salary should be the small percentage of your economies, otherwise you have lost where there is no reasonable return upon the investment.

Command the attention of those above, but not in a spectacular manner, advertising your ability in a modest way. Work well, even if not appreciated; others are watching, and even those in minor positions may at some future time recommend or employ.

Contributed by T. W. Reynolds

Soot and Soot Blowers

Nature of soot and its effect on heat transfer through boiler heating surface. Relative steam consumption of mechanically operated soot blowers versus hand cleaning. Effect on the coal pile, labor required and maintenance cost of mechanical blower as given by a number of users.

DURING recent years the boiler room has gradually emerged from a position of secondary importance to a primary element in the cost of power generation. Boilers have been growing in size, combustion rates have increased, and greater loads per unit of steam-making surface are being carried. With the operating conditions becoming more severe and fuel cost high above the normal level of years past, closer scrutiny is being given all factors affecting economy.

Of all the preventable losses, that caused by the formation of soot on the fire surfaces of the boiler is perhaps the most troublesome. Cracks in the setting may be detected, and the leakage of air into the setting may be stopped. Proper insulation will reduce radiation, and scale on the water surfaces may be eliminated to a large extent by the use of pure or softened water. The formation of soot and ash, however, is universal and continuous as long as there is an active fire under the boiler. Depending upon the degree of combustion and arrangement of the setting, the quantity of soot varies and its character differs with the fuel, but there is no stopping of its formation. Even if conditions were ideal and combustion complete, a heat-insulating coating composed largely of ash would form on the tube surface.

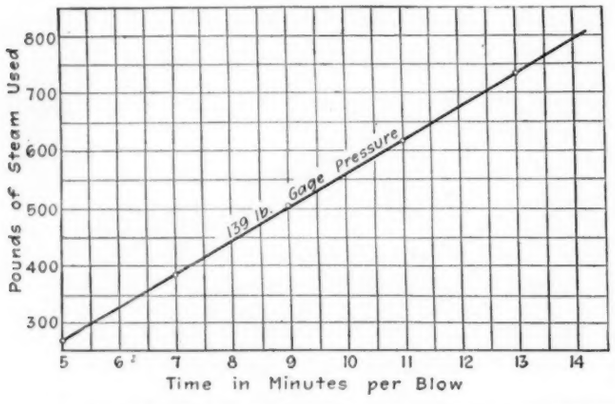


FIG. 1. TOTAL STEAM REQUIRED FOR PERIODS BLOWER IS IN OPERATION

As a rule the soot found in boilers is not pure soot or carbon. It contains a varying proportion of ash, so that the color may be light gray, red, brown or, where conditions are particularly unfavorable to good combustion, black. In coming from the furnace, the soot particles are more or less plastic and readily adhere to the metal surface of the tubes. Unless the deposit is quickly removed, the carbon on the tubes near the fire will burn out in part, fusing the various ingredients into a hard coating, which increases rapidly as the gas temperature rises due to the insulation of the tubes. In water-tube boilers it is not uncommon to find on the heating surface near the fire hard clinker-like formation in some cases bridging the tubes. Even with efficient and frequent cleaning it is practically impossible to keep the lower tubes near the fire entirely free of this slag-like formation. Farther back the soot does not contain so large a percentage of ash. It is usually darker in color, and the formation is not cemented together. Loose deposits rest on all retaining surfaces, such as the upper portions of the tubes.

With all kinds of fuel then there is formation of soot. Anthracite contains a low percentage of volatile matter,

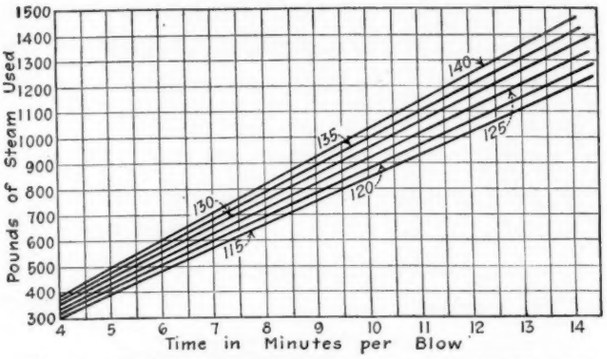


FIG. 2. STEAM CONSUMPTION OF 2-IN. BLOWER FOR VARIOUS PRESSURES

but may run high in ash, so that the deposit is largely the latter constituent and is usually of a light powdery character. With bituminous coal, high in both volatile and ash, there is a large percentage of carbon in the soot, particularly if the furnace conditions are not favorable to good combustion. In waste-heat boilers deposits of fine powdered dust carried along with the gas are to be found, and even with oil fuel there is some formation of soot. Due to excellent combustion the quantity is small, but as the deposit is pure soot of high insulating value, its removal is important from an efficiency standpoint. The soot evil also extends to the economizer, the deposits resembling the boiler soots. Due to the lower temperatures the formation is more profuse and its interference with heat transmission relatively greater as the difference in temperature between gas and water is less.

It has been commonly stated that next to loose wool, loose lampblack or soot is the best insulator known. In this capacity it is ahead of hair felt, and is more than five times as effective as fine asbestos. All this may be true, but boiler soot is not all lampblack. The varying percentages of ash and the density and structure of the deposit will naturally affect the insulating properties. Besides, the coating is not evenly distributed so that part of the surface at least will be comparatively clean. If the maximum heat transfer through the boiler tubes is to be maintained, however, all the heating surface must be kept clean, and this is particularly true where boilers are forced over normal rating, as is the practice in modern plants. If the soot is allowed to remain, another bad feature is the formation of carbonic and sulphuric acids, which act on the metal of the boiler, causing leaky tubes and general

deterioration that will shorten the useful life of the boiler. It is quite evident, then, that soot must be removed if the best results are to be obtained, and the question at issue is the easiest and most efficient method of doing it.

For the purpose there are the hand lance and the mechanical blower. The former, consisting of a rubber hose and nozzle, was the first device to be used. It is of course simple and the initial cost is small. Two men are required to operate it: one at the boiler to handle the nozzle and the other at the steam valve. The work is naturally hot, dirty and disagreeable and on a medium-sized boiler takes from twenty to thirty minutes. Usually there is not more than one and at most two blowings per day of twenty-four hours. The lance is

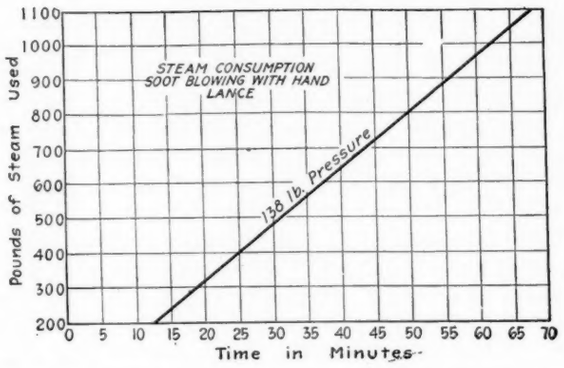


FIG. 3. STEAM CONSUMPTION WITH HAND LANCE

inserted through dusting doors in the setting, and there is no opportunity for the operator to see the result of his work. Unless he is conscientious beyond the average, the surface may be poorly cleaned and some sections are neglected entirely. Usually, the lance does not reach all the heating surface, the area covered being determined by the kind of dusting doors, the width of alley space at the side of the boiler and the range of the lance due to the angle of the dusting door. Another objection commonly advanced against hand-blowing is the fact that when soot is blown across the tops of the tubes it strikes the battery wall and tends to pile up on the far tubes, contrary to the argument that the draft will carry it off.

There is the additional objection of large quantities of cold air being drawn into the setting during the period the steam lance is in operation. This means less efficient combustion. As expressed by A. W. Conklin, in *Power*, July 13, 1915, the time required to clean a boiler with a steam or air lance is about three times that necessary with a mechanical blower, and the results obtained are about one-third as good. In a series of comparative tests in soot blowing, it was found that the amount of steam required for one operation of the mechanical blower was about the same as that used in blowing the boiler by hand. In other words, the amount of steam used by the blower in 6 minutes, the time required to clean the boiler, was nearly the same as that used by the steam lance in 25 minutes for the same operation. The mechanical blower, however, showed a saving of 5 per cent. over hand-blowing, because the heating surfaces were more thoroughly cleaned. This figure appears to be conservative and when in average practice neglect or less frequent cleaning are factors, the saving may easily be more.

Continuing with the results obtained by Mr. Conklin, Fig. 1 shows the steam consumption of a soot blower equipped with 1½-in. piping to the blowing elements. The steam pressure was 139 lb. gage and the superheat about 20 deg. Between the main steam header and the nozzle plugs there was a drop of about 10 lb. pressure when the blower was in operation. The test was made on a 300-hp. water-tube boiler vertically baffled for three passes. Two blowing elements in each pass cleaned the tubes. In addition an element served the superheater and another was placed in the rear combustion chamber. Fig. 2 shows the steam consumption of a 2-in. blower at different steam pressures and 20 deg. superheat on a 500-hp. boiler of the same type served by the same number of blowing elements. Fig. 3 gives the steam consumption of a hand lance on the smaller boiler. With the latter the superheater tubes were not blown, nor was the rear combustion chamber cleaned, but the steam consumption was about the same as that required for one blow with the mechanical blower. The blower required 29 min. and the steam at 138 lb. pressure was used 25 min. at the rate of 16 lb. per min. Temperature readings taken at the top row of tubes, third pass, showed that the gases from the mechanically cleaned boilers were anywhere from 80 to 100 deg. lower, say 520 deg., as compared to 620 deg. for the hand-cleaned boiler. This corresponds to a saving of from 4 to 5 per cent. made possible by more efficient and more frequent cleaning.

Drop in Uptake Temperature

From general observations and figures from various tests a general rule has been figured out that for every 20 deg. drop in the uptake temperature due to the removal of soot from the heating surface, there is a saving of approximately 1 per cent. in fuel. It is well to bear in mind that a drop in flue-gas temperature may mean better absorption of heat or it may mean a temporary cooling of the surface by the blowing steam. The time element in the return of the temperature to that before blowing is the deciding factor. A rapid recovery indicates cooling while a slow gradual rise in the temperature shows efficient cleaning. Fig. 4 is an example of the latter condition. The curve is a plot of flue tem-

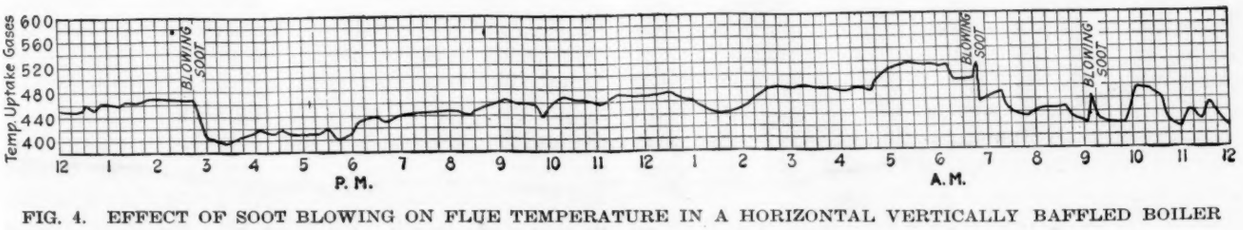


FIG. 4. EFFECT OF SOOT BLOWING ON FLUE TEMPERATURE IN A HORIZONTAL VERTICALLY BAFFLED BOILER

peratures in a horizontal vertically baffled water-tube boiler burning Illinois coal in an underfeed stoker. After the blowing at 2:45 p.m. there is a sudden drop in temperature of 70 deg. The succeeding rise in temperature is gradual, as the curve does not reach the original level until midnight, about nine hours later.

Labor is another item entering into the comparison. The mechanical blower required but one man and the time of blowing is, say, one-fourth as long, so that the ratio in this case was 8 to 1, and with very large boilers it may be considerably higher. Local conditions, size of plant, etc., determine whether the saving in time will be sufficient to dispense with the services of employees retained for this work.

Objections offered to the mechanical blower are initial cost, running from 5 to 10 per cent. of the cost of the boiler, the burning out of the elements exposed to the hottest gases direct from the furnace, and warping. The objection last named, warping, has always been a serious problem. It is a well-known fact that metal begins to warp long before it reaches a temperature that will cause corrosion or burning of the metal. For that reason it is necessary to construct the element so that it will have strength to resist the warping, for as soon as this action begins, the element will be thrown out of line, it will bind in the bearings and the operator will be unable to turn it.

Initial Cost Small

The initial cost is comparatively small when compared to a 5 per cent. saving in the fuel bill, the reduction in labor and the convenience of operation. Destruction of the elements near the fire has been obviated to some extent by the use of special metal having high heat-resisting qualities, and by so placing the elements that they are protected from the direct heat of the furnace when in the nonoperating position. Corrosion, due to back suction of the boiler gases into the blowing elements, has been reduced by the use of special air valves, and special precautions have been taken to drain the piping system of the blower to prevent condensation being forced out onto the heating surface to interfere with soot removal and to corrode the metal. These various improvements, better placing of the elements and nozzles of improved design have so perfected the mechanical blower that, according to reports from numerous users, the services rendered are excellent and the maintenance charges are comparatively small.

While users of the mechanical soot blowers realize that they are getting better heat transfer, that the flue gases are lower in temperature and that the boiler efficiency has been improved, there is a lamentable lack of specific data showing the saving actually effected and the average cost of maintenance. The blowers have been installed. They are giving satisfaction. The boilers will carry more load, and it is known that the flue temperatures are considerably lower than previous to the installation. During the first two or three years of use repair parts are required occasionally. Depending upon the service the average life of the blower is at least five or six years. The labor of blowing has been reduced, and as the work is less arduous, it is performed more frequently and with better results.

Such was the gist of replies from a large number of power-plant owners and engineers to whom inquiries had been sent by the writer concerning the saving in fuel and labor effected by the installation of mechanical blowers, the cost of maintenance and the degree of satisfaction the blowers gave in service. The substance of some of the replies, more specific than others, are presented in the following:

The Iowa Falls Electric Co. had equipped three Edge Moor water-tube boilers of the four-pass type with soot blowers. Two of the boilers were rated at 410 hp. and the other at 550. The boilers had previously been blown by hand, and the work required the full time of one man at a cost of $850 per year. In their opinion it took a remarkably good man to stand up beside a hot boiler and blow every tube. Frequently some of the tubes were missed, and the result was a reduction in efficiency. Besides, a man could not hold a hose carrying 175-lb. steam pressure. It had taken the company two months to get all the old scale off the tubes, caused by blowing them with wet, low-pressure steam. The principal advantages of the mechanical blower in their estimation was the fact that full boiler pressure could be used and that better results were obtained. Since the installation of the blowers the services of the man previously mentioned had been dispensed with, and the firemen were blowing the tubes twice on every shift. The saving in coal was placed at 15 per cent. The blowers had been in service one year, and the maintenance expense had been the cost of one pint of oil to lubricate the swing joints.

Make a Saving

The Iowa Railway and Light Co., of Cedar Rapids, had installed mechanical soot blowers on 29 Edge Moor water-tube boilers during a period extending from 1909 to 1918. The company knew that the blowers were a great help both in labor and economy, but could give no definite figures. It had been found that the blowers would not keep clinkers off the first row of tubes. There was a chance for improvement here.

In the plant of the Indianapolis Light and Heat Co. 14 boilers, ranging in size from 500 to 800 hp., were equipped with mechanical blowers. If properly operated, the blowers saved approximately 15 per cent. in fuel and labor. About 12½ per cent. of this saving was attributed to higher boiler efficiency and 2½ per cent. to a reduction in labor cost. The maintenance had been approximately $5 per installation per month.

The Richmond Light and Railroad Co. had blowers on ten 606-hp. B. & W. boilers equipped with stokers. The maintenance on the blowers, which had been installed from one to two years, had been practically nothing. The company had no accurate data to show the saving in coal and labor, but was satisfied that the blowers were a good investment.

The Edison Electric Illuminating Co. of Brooklyn had in use blowers on 17 B. & W. boilers averaging 650 hp., and 45 additional units were being installed. Installation work had begun in November, 1916, and no definite figures as to fuel saving were available, as the majority of the boilers were still blown by hand. In the opinion of the operating engineer there was no question that the boilers were much cleaner by the use of the mechanical soot blowers, and that a saving in fuel must result. When all the soot blowers were

installed, the labor saving would eliminate the services of five men and would amount to about $13 per day.

Soot blowers on 4900 hp. of Stirling boilers are in use at the plant of the Indiana Railways and Light Co., of Kokomo, Ind. No tests had been made to determine the percentage of saving. Cleaner tubes so clearly indicated a saving that the question had not been analyzed. It had been their experience that the soot blower complete had to be removed in from five to six years.

Four 750-hp. Bigelow-Hornsby boilers in the plant of the Salem Electric Lighting Co., of Salem, Mass., had been equipped with soot blowers in 1915; five blowers were installed on 280-hp. Heine boilers in the plant of the Rockland Light and Power Co., of Nyack, N. Y., in 1914, and in the same year a 600-hp. B. & W. boiler of the Malden Electric Co., of Malden, Mass., was equipped with a blower. In the plant first mentioned the saving in labor was $675 per year; in the second plant $411 per year, and in the Malden plant the labor saving was undetermined. Blower repairs in the three plants had been negligible. In the opinion of the engineering manager controlling the three properties, there was no question but that there had been a saving in fuel on all the boilers equipped with mechanical soot blowers, as it was possible to clean the tubes twice in twenty-four hours so that the heating surface was maintained in much better condition. No exact data were available.

Better Than Air Blowers

The Central Hudson Gas and Electric Co., of Poughkeepsie, N. Y., had equipped six of eight Stirling boilers with mechanical blowers. These blowers were much more effective than the compressed air they had previously used, and there was a considerable reduction in labor.

Installation of soot blowers on two 400-hp. Heine water-tube boilers in the plant of the Chester Valley Electric Co., of Coatesville, Penn., in the year 1911, had resulted in a saving in the operation of the plant roughly estimated at 5 per cent. This figure was considered conservative and was divided into 1 per cent. in labor and 4 per cent. in fuel. The maintenance charges, which had been small, were placed at $100 in seven years.

With blower installations on two 350-hp. Heine boilers and two Stirling boilers for several years, the Texas Power and Light Co. placed the cost of upkeep at $5 per blower per year, and over hand-blowing estimated a saving in fuel of approximately 10 per cent.

The public lighting plant of the City of Detroit had installed soot blowers on two 685-hp. Stirling boilers Apr. 21, 1916. To clean the soot from two 400-hp. Stirling boilers by means of a steam hose from ladders required the labor of two men for about three hours. With the mechanical blowers the battery of two 685-hp. boilers was cleaned by one man in one-half hour, the ratio being 12 to 1 in favor of the mechanical blower. So far there has been no expense for maintenance.

One of the large central station companies of the country has equipped 55 boilers with mechanical soot blowers. These are of competitive types, and a few of home manufacture. Fifteen of the installations have been made on Stirling boilers rated at 2365 hp. that operate between bank and about 200 per cent. of rating. On overload the temperatures are high and the conditions severe, so that it has been found necessary to assist in the further development of the blowers. To clean one of the large boilers by hand requires twelve to fourteen hours' time with two men operating. These men receive 38 cents per hour, so that the labor cost for hand-blowing averages about twenty-six hours of 38-cent time, or just under $10 per 2500 boiler horsepower per twenty-four hours.

With soot blowers installed two men blow a boiler in about one hour. They blow each boiler three times a day so that the total labor cost approximates $2.30 per 2500 boiler horsepower per twenty-four hours. Thus the labor item is reduced to less than one-fourth, and the boiler has the advantage of three cleanings a day. The job is much better done, and no useless air is admitted through open doors. The effect of this factor will be appreciated when it is noticed that it takes from twelve to fourteen hours to blow one of the boilers by hand.

To clean one of the big boilers with a mechanical blower required about 3500 lb. of steam per blow. Three operations per day would require about 10,500 lb. of steam per 2500 boiler horsepower every twenty-four hours.

The maintenance charges on soot blowers had not been separated from certain other somewhat similar costs, but it was estimated that soot blowers properly installed could be kept in good operating condition with a maintenance expenditure of not over $200 per 2500 boiler horsepower per year. The average charge had been higher than this, but it was due to the fact that certain parts as originally designed and installed had given out frequently and had to be replaced. Because of imperfect methods used for measuring flue-gas temperatures, accurate data were not available to indicate the thermal advantage obtained from the use of soot blowers. It was believed safe to assume, however, that mechanical soot blowing maintained a flue-gas temperature about 30 to 40 deg. lower than could be maintained with hand-blowing, and unless the latter operation was completely and conscientiously done, the difference would be more nearly of the order of 80 to 100 deg. less.

Loss of Flowage Rights

Under the laws of New York, right to dam a stream, when acquired and held under an express deed or grant, cannot be lost by mere nonuse unless the disuse has continued for at least twenty years. And when a dam has been maintained at a given height for that period or longer, a prescriptive right is acquired, irrespective of any express grant. Where there has been no relinquishment of an acquired right to flood lands, through express relinquishment or continued nonuse for twenty years, the owner of the dam is entitled to reconstruct it at such height as to overflow upper lands to the full extent permitted under the original grant of right. Hence, the fact that an old dam may have leaked for many years, less than twenty, will not affect the right of the owner to repair the leaks, or reconstruct the dam, so long as no more land is overflowed than was overflowed in the original enjoyment of the right. (New York Supreme Court, Ulster County; Geiger vs. Divine, 167 New York Supplement, 263.)

Augustine Rotary Two-Cycle Super-Induction Gas Engine

ONE of the most widely used engines for airplane work is the revolving air-cooled motor, of which there are several designs, operating on the four-stroke cycle. The distinguishing feature of this type of engine is that the crankshaft and cranks are stationary and the cylinders revolve about this shaft. This produces the same relative motion of the piston to the cylinder as if the cylinder were stationary and the crank revolved, as in the case of an ordinary reciprocating engine. These engines are generally made with 5, 7, 9 or 14 cylinders and range from about 50 to 100 hp. each.

A new design of rotary gas motor is the Augustine rotary two-cycle super-induction air-cooled engine, Fig. 1, which has been developed by the Augustine Automatic Rotary Engine Co., 1862 Elmwood Ave., Buffalo, N. Y.

Figs. 2 and 3 illustrate the general design of this engine; the former is a sectional view through the motor in a plane at right angles to the axis of the driving shaft and centrally through the cylinders, also showing the relative positions of the pistons in the radial cylinders and the stationary shaft, bearings and connecting-rods. Fig. 3 is a sectional view in the plane of the axis of both the stationary and driving shafts, showing the assembled parts and how the lubricating oil is carried in copper tubes to the bearings and how the oil is kept cold by the incoming charge of gas.

The fuel gas is drawn from the carburetor through the hollow shaft *A*, Fig. 3, by the pumping action of the piston and is delivered to the crank casing, where it is put under slight compression, the degree of compression being controlled by the throttled condition of the carburetor. The passage of the fuel gas is from the hollow shaft *A* through the stationary controlling valve *B* and intake pipe *C* to the space *D* in the cylinder between the piston and the cylinder head, as shown by the arrows. As the sleeve valve *E* has closed the exhaust ports when the piston is at the compression position, the gas in the space *D* is forced back through the pipes *C* and *F*, past the valve *B* and into the crank casing of the engine when the piston begins its outward stroke, the valve *B* having moved to permit of its passage and so has cut off the supply of gas from the carburetor from the cylinder that has reached the compression stroke.

Fig. 4 is a sectional view of the stationary controlling disk valve showing the alternately intaking and discharging pipes that lead to the different cylinders. It also shows by the arrows the intaking of the charge from the carburetor and the discharging of the gas charge into the inner chamber by positive cutoffs above and below, the engine rotating in the direction of the curved arrow. As shown, the gas passes to the chamber *D*, Fig. 3, at the same time and is being forced into the crank casing from two opposite cylinders during the same period.

The fuel gas passes directly from the crank casing to the cylinders, entering through the intake ports *G*, Fig. 3, which are at the inner ends of the cylinders. A separate view of the piston, ports and cylinder is shown in Fig. 5, which also shows how the super-induction is effected, the sleeve *E*, Figs. 3 and 5, having closed the exhaust ports and the full pressure of the inner chamber being admitted into the cylinder before cutoff and compression begin.

With the piston at the inner end of the cylinder, Fig. 6, and the exhaust ports closed, the cylinder is filled with fuel gas drawn from the carburetor through the hollow shaft and intake pipe leading to the outer end of the cylinder. The greater piston area on the pump side is responsible for the super-charge that is brought in and then transferred to the inner chamber as the piston reaches the other end of the stroke. Compression is effected between the inner face of the piston and the inner end of the cylinder before exploding and expanding, and the spark plug *H* is located in the center of the charge. The screen on the intake ports *I* is to prevent backfiring.

After the explosion in any one of the six cylinders takes place, the burnt gases are expelled through the exhaust ports *J*, Fig. 3, at the outer end of the cylinders. These exhaust ports are controlled by a sleeve which is positively moved by the cams and push-rods *K* and *L*, the movement of the sleeve being so timed as to close the exhaust ports prior to the closing of the intake ports *G*. By this super-induction, brought about through the closing of the exhaust ports and the pumping capacity of the piston, which can deliver a large volume of gas to the cylinders, a very high volumetric efficiency is obtained, even at high altitudes in airplane service where low atmospheric pressures are encountered.

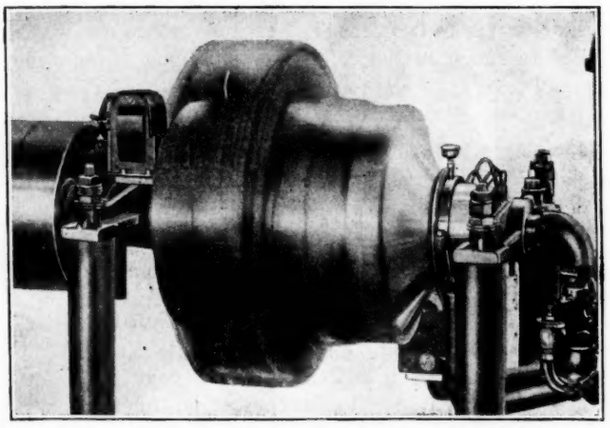


FIG. 1. THE AUGUSTINE ROTARY ENGINE RUNNING AT HIGH SPEED

An idea of the action of the gases in each cylinder may be obtained from an examination of Figs. 7 and 8. The former shows the piston position just as the exhaust gases are released by the piston uncovering the ports and thereby relieving any pressure before the inlet ports are open. Fig. 8 is a similar view, showing the intake ports open and the cylinder fully scavenged of the burnt gases and the sleeve at the point of closing the exhaust ports. It also illustrates how the spark plugs *H* have a complete scavenge with the new, clean charge of dry gas, insuring easy ignition. As the exhaust ports are at the outer end of the cylinder and the inlet ports

at the inner end of the piston cylinder, this prevents cycloning of the inrushing gases and causes natural scavenging, owing to a "uniflow" of the gases.

In Fig. 9 is shown a partial view through the upper portion of a cylinder at one side, with the piston just closing the exhaust ports and the sleeve for the closing of the exhaust ports about to move and uncover them. At this position of the piston there is no pressure on the sleeve, therefore it is moved practically without friction. Fig. 10 is a similar view showing the exhaust ports uncovered by the sleeve and the piston just reaching the space of the piston, forcing it outward and pulling on the fixed crank to turn the engine rather than thrusting against the crank. The expanding force of the gas against the piston operates in the same direction as the centrifugal force and is added thereto, and does not destroy the balance of one piston against the other. In this connection another advantage is accomplished in that the thrust of the expanding gases against the cylinder forces the cylinder against the crank casing, so that the only necessary connection between the cylinder and the crank casing is to overcome the centrifugal

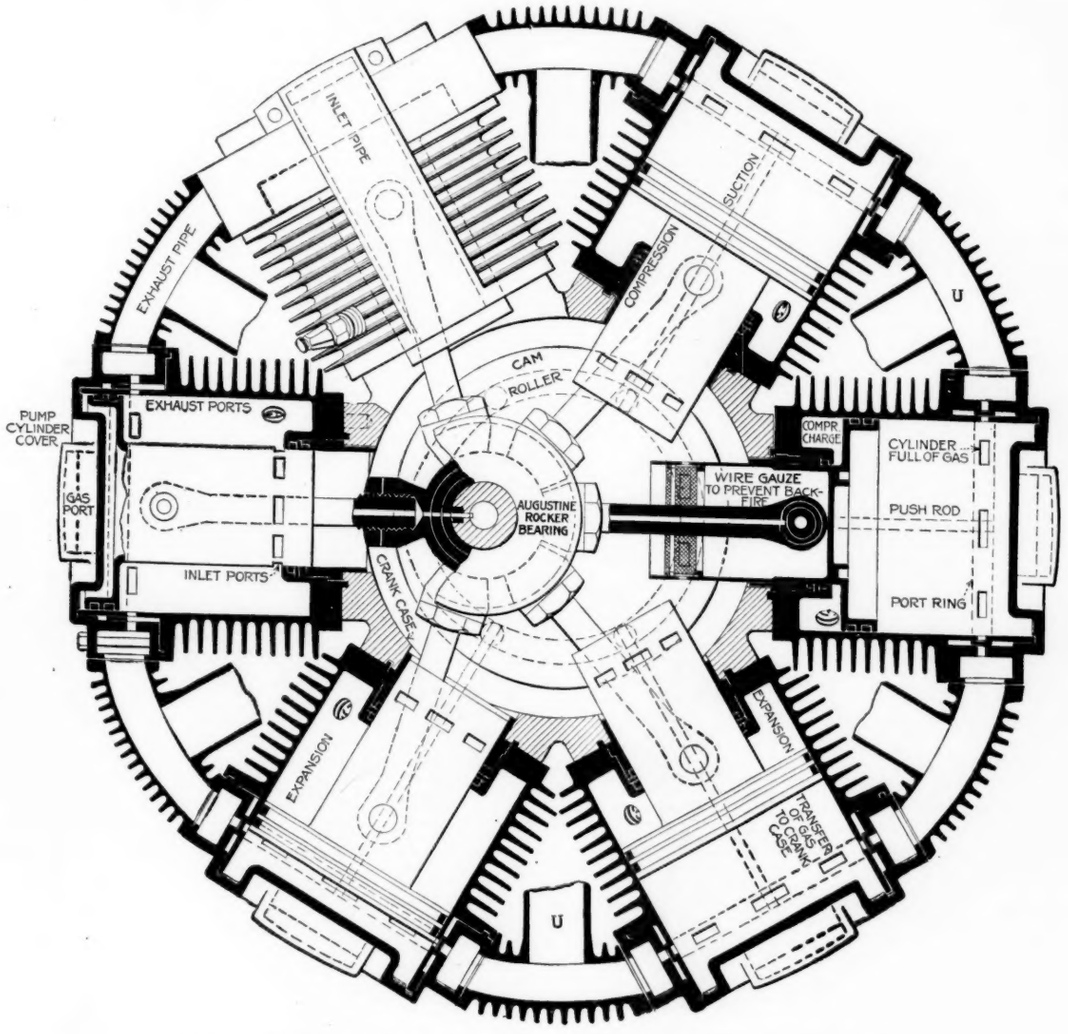


FIG. 2. END SECTIONAL VIEW THROUGH THE AUGUSTINE ENGINE

ports, which it also uncovers and thereby effects the exhaust. After the compressed charge has been exploded and the piston has moved to its outer stroke, the sleeve valve *E*, Figs. 3, 9 and 10, uncovers the ports *J* and the incoming charge of fresh gas from the crank casing forces the burnt gases out through the ports *J* into the exhaust pipes *U*, Figs. 2 and 3. This cycle of events takes place in each cylinder in rotation.

In the operation of the rotary type of engine centrifugal force has to be contended with, and this becomes an enormous factor in a high-speed engine. The Augustine engine overcomes this difficulty by arranging the expansion and compression chambers for the fuel gases so that the expanding gases work against the inner action on the cylinder. Records show that many accidents have occurred by the cylinder breaking loose through the tremendous pressure of the expanding gases combined with centrifugal effect, which tends to force the cylinder outward. In this engine, however, this is overcome because the pressure of the expanding gases against the inner end of the cylinder tends to hold it seated against the crank casing.

An essential feature in an airplane engine is extremely light weight. In this engine each cylinder is divided by the piston into a pumping chamber and an expansion and compression chamber for the fuel gases, as already mentioned. The gases are pumped by the same piston that is acted upon by the expanding gases, thus making

the piston double-acting. By using the one cylinder both for pumping gases and for the expansion of the gases in turning the engine, the latter may be made very light, because the expansion of the gases is against the inner end of the cylinder and the crank casing, and the outer end of the cylinder is only subjected to the suction and the discharge of the gases. In other words, the force of the expanding gases is practically taken up by the piston head and the crank casing itself. As the ports are at the extreme inner end of the cylindrical portion carried by the piston, the moist gases are carried by the centrifugal force past the intake ports and gasified, and only dried gas passes through the intake ports to the cylinder. Furthermore, the fuel gases come in contact with the inner central portion of the piston head, and at the same time the fuel gases in the pumping chamber come in contact with the outer face of the piston head. This tends to keep the piston head cool

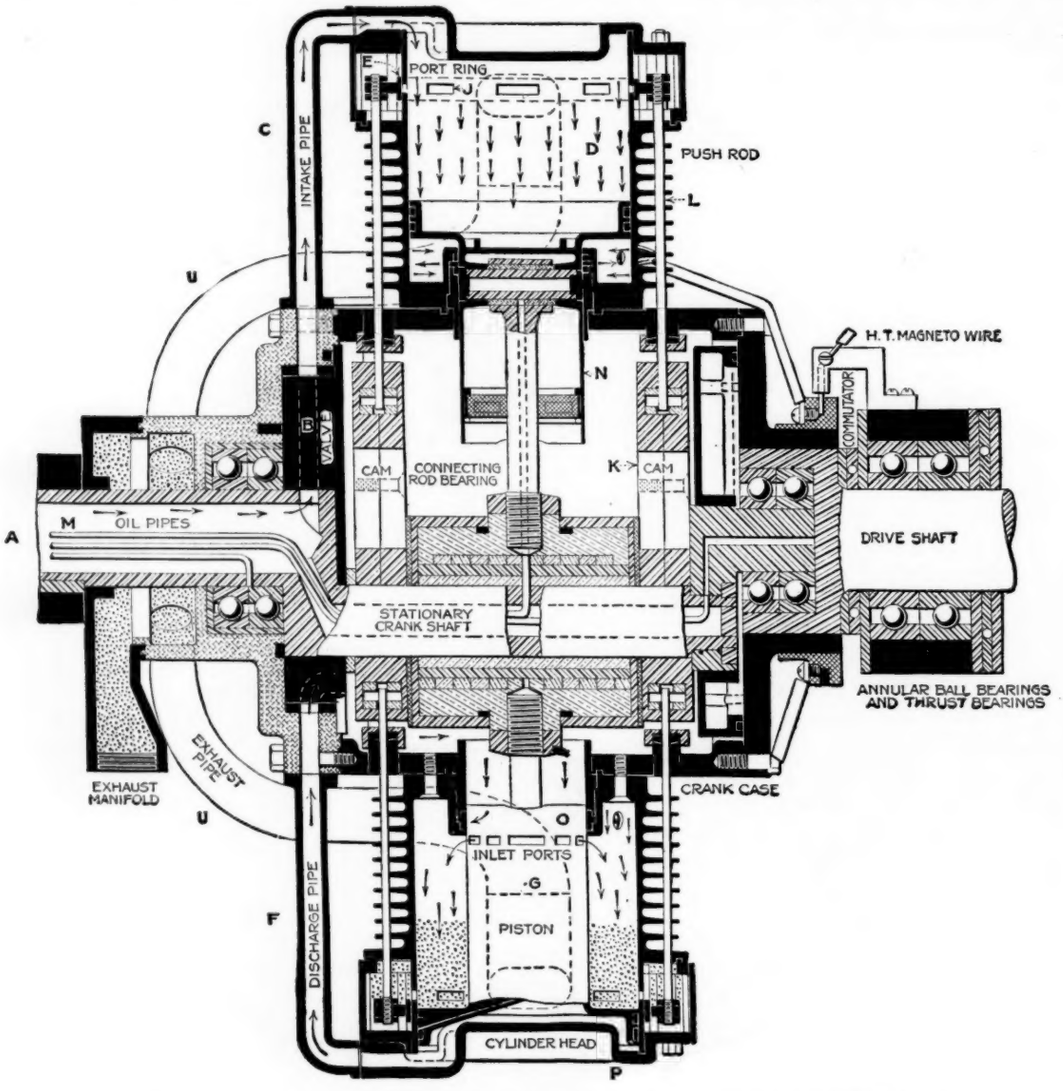


FIG. 3. SIDE SECTIONAL VIEW THROUGH THE TWO-CYCLE ROTARY ENGINE

sleeve that controls the gas ports is also timed to cover the exhaust ports when the outer end of the cylinder operates as a pumping chamber, this not only obviates the loss of fuel gases being pumped, but also prevents the burnt gases from being thrown back into the pumping chamber.

The cylindrical projection *N*, Fig. 3, extends inwardly from the piston head and from the housing from the piston-rod connection and also contains the intake port. This cylindrical projection is opened to the crank casing so that the cooled fuel gases pass up into them and the moist gases, particularly, are carried by centrifugal force into the cylindrical projection, which becomes in a way a vaporizer for gasifying the fuel. As the intake while the heat units tending to accumulate therein are utilized for gasifying the fuel.

The piston with its cylindrical projection has a two-point bearing, one at each end of the expansion chamber. As the piston travels, the connecting-rod assumes a position at an angle to the longitudinal center line of the cylinder, and this has caused considerable difficulty in previous engines, owing to the side thrust or twist of the piston wearing the cylinder wall. By this construction, however, where the piston has a two-point bearing, as at *O* and *P*, Fig. 3, this side thrust or lateral twist in the piston is taken care of with little or no wear of the piston on the cylinder wall. Furthermore, by this two-point bearing the extent of the contact surface between

the piston and the cylinder wall is reduced to a minimum and the friction incident to the travel of the piston is thereby reduced.

The exhaust ports are large and are disposed about the end of the cylinder. The intake ports are disposed about the cylindrical portion carried by the piston and

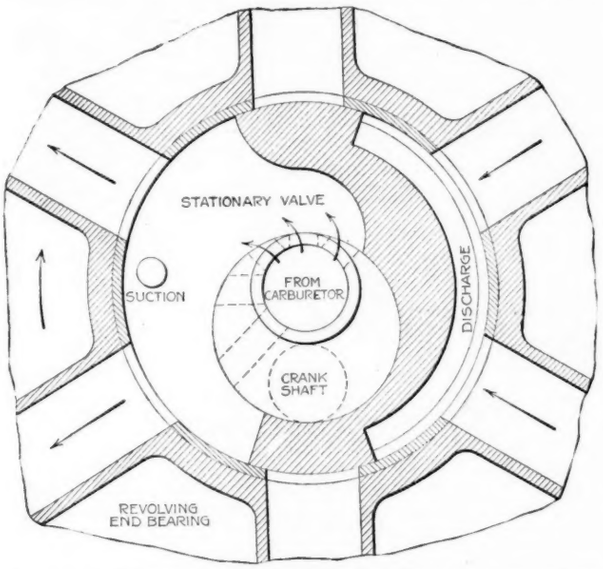


FIG. 4. SECTION THROUGH THE STATIONARY CONTROLLING DISK VALVE

are in line with the exhaust ports. As a result, when the exhaust ports are open and the intake ports uncovered, the gases rush through the latter and force the burnt gases out of the former, thus scavenging the cylinder. As already stated, the central portion projecting from the piston prevents cycloning of the inrushing gases and intermixing with the burnt gases.

Each piston rod is connected to a pair of rings, and these rings are nested and engage two floating sleeves mounted on a fixed crank. By having a pair of rings, all side thrust on the piston rod is avoided. The end cups surround the ends of the connecting bars carrying the rings. A compression ring is slipped over the connecting bars and engages the groove therein. This compression ring also engages the inner surface of the cups and thereby forms in each cup a lubricating pocket. The oil for lubricating the crank is carried by a copper tube through the hollow fixed shaft as at *M*, Fig. 3, and passes out through oil grooves in and about the floating sleeve into the end cups and also out through the connecting-rod to the wristpin and to oil ducts leading to the cylinder walls. This arrangement gives lubrication for every desired part of the engine, and also insures that the fuel gases are free from the lubricating oil.

A side elevation through the center of the self-aligning bearing is given in Fig. 11, in which the two inner sleeves and the oil channels are shown, also the end cap bearings that inclose the outer section of the bearing. The two expansion rings on the inner ends of the caps are for retaining the oil film. Fig. 12 is an end view showing the various sections of the self-aligning bearing and the oil ducts leading up through the connecting-rods to the wristpin, through which the oil is equally distributed by centrifugal force through all parts while the engine is in operation. The ensemble of this self-aligning bearing insures alignment of the piston rods between the crank and the wristpin centers and at the same time constitutes the center along which all pistons and their rods revolve in a balanced centrifugal condition, with no reversal of direction of pull on the connecting-rods. Fig. 13 is a perspective view of two of the self-aligning bars with annular rings, which, when assembled, are mounted on inner creeping sleeves.

As the engine is of the two-stroke cycle type, the cylinders are fired in rotation one after the other. This gives a constant torque and permits of the use of a very simple ignition device; for example, in a six-cylinder engine a two-point magneto may be used, driven at a speed of three to one with a single wire leading to a brush-holder coöperating with spaced contacts connected to the respective spark plugs in each cylinder. The brush engages these contacts in rotation. The spark plugs are directly in front of the incoming gas, which assures perfect scavenging and allows the motor to be throttled to a very low speed and at the same time insures that the spark plug shall be in the region of the fresh fuel gas. A diagram showing the inlet and exhaust cycles of the motor and the section of the box cam that closes the exhaust ports in each revolution is shown in Fig. 14.

Following are given data of the more essential features of this engine: Number of cylinders, 6, having six double-acting pistons utilized both as power pistons and pumps; bore of working cylinder, equivalent in area to a 4⅝-in. conventional piston; stroke, 4 in.; area of piston, 16.7 sq.in.; area of pump, 23.76 sq.in.; connecting-rod crank ratio, 4 to 1; bore of crank case, 10¼ in.; over-all diameter of motor, 26 in.; over-all length of motor, 24 in.; two-spark magneto, driven 3 to 1, giving six sparks per revolution; approximate weight of motor, 2 lb. per hp.; compression, from 90 to 100 lb. per sq.in.; positive system of force-feed lubrication.

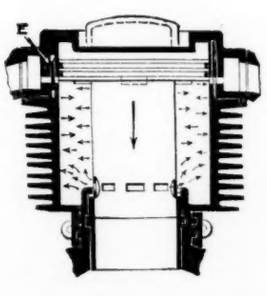


FIG. 5. PISTON PORTS AND CYLINDER

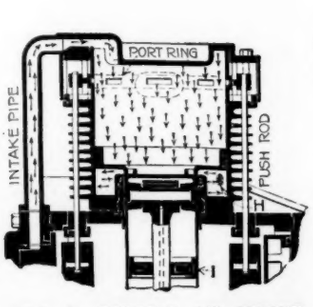


FIG. 6. PISTON AT INNER END OF CYLINDER

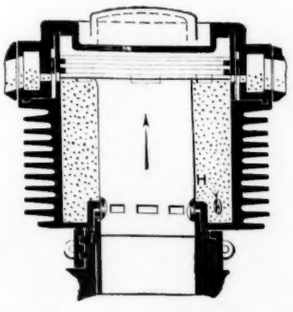


FIG. 7. PISTON AT EXHAUST AND RELEASE

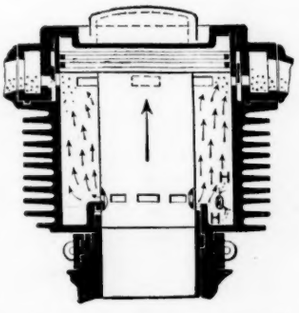


FIG. 8. INTAKE PORTS OPEN

The engine is started by turning the switch of the magneto and pressing the button of the self-starter. When the engine is stopped by turning off the switch all the cylinders are charged with fresh fuel from the inner chamber and are ready for the next operation. The engine can be started with a coil and battery if desired. It is made reversible by simply adding a sleeve to reverse the inlet and transfer ports. The engine is practically fool proof for the reason that there are no adjustments to be made.

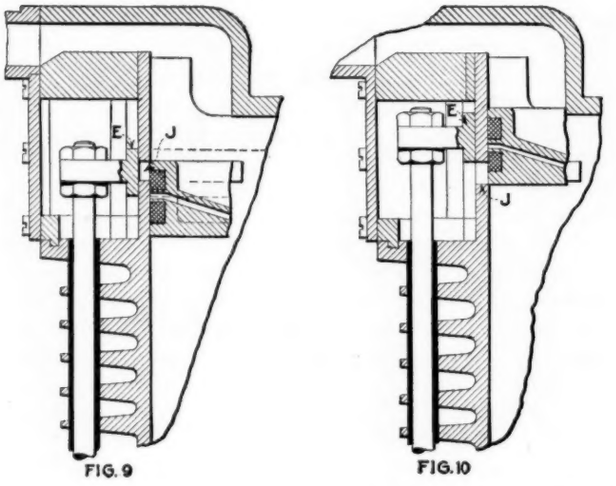


FIG. 9 FIG. 10

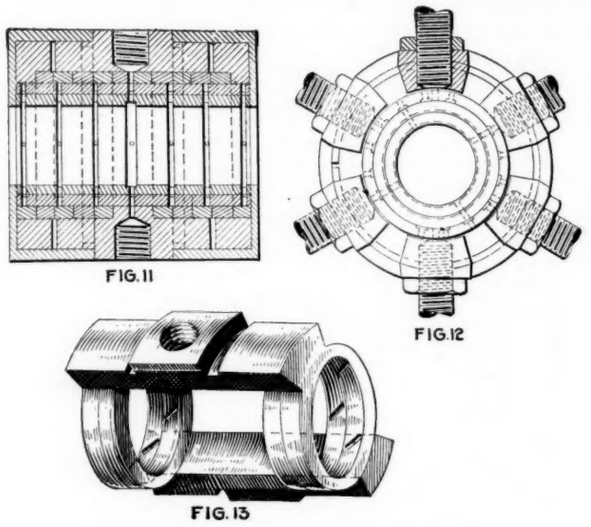


FIG. 11 FIG. 12 FIG. 13

FIGS. 9 TO 13. SECTION OF CYLINDER, PISTON, SLEEVE VALVE AND SELF-ALIGNING BEARING
Fig. 9—Piston just closing exhaust ports. Fig. 10—Exhaust ports uncovered by sleeve ring. Fig. 11—Section through self-aligning bearing. Fig. 12—End view of bearing. Fig. 13—Two of the self-aligning bars

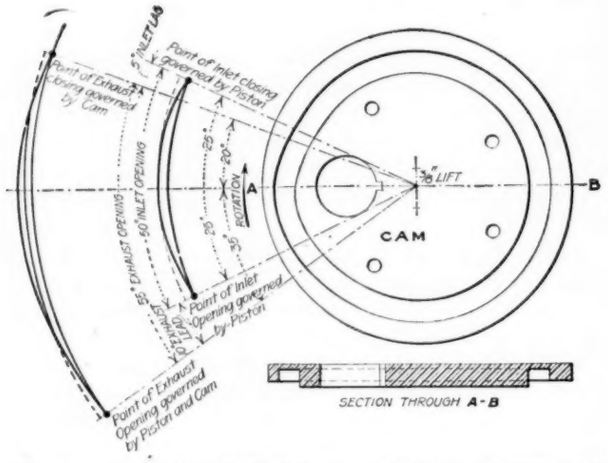


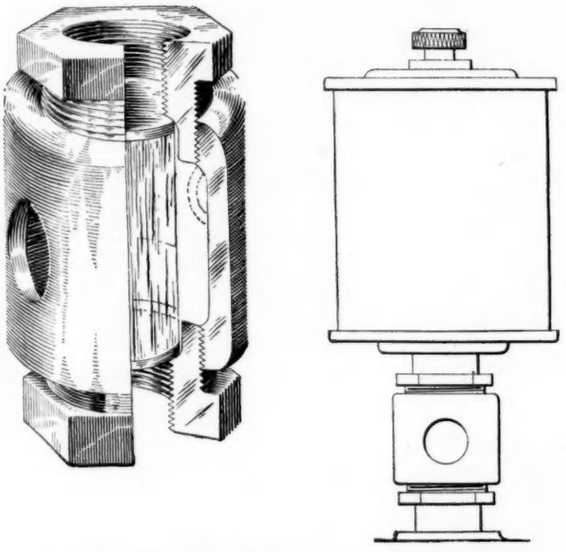
FIG. 14. DIAGRAM OF INLET AND EXHAUST CYCLE, ALSO A SECTION OF THE BOX CAM

Sight Feed for Oil Cups

BY F. W. BENTLEY, JR.

The lower, or sight-feed, portion of heavy oil cups is frequently broken, due to lightness in the construction of the average frame holding the glass—heavy enough, of course, to support the lubricator under ordinary circumstances, yet too easily broken in case of accident. The lower end of the oil cup or lubricator can in most cases be retapped and fitted again to give service, but the sight-feed glass retainer or receptacle is a hard thing to repair and it is difficult to get something to work as a substitute.

The illustration shows how a sight-feed arrangement can be made out of two pipe-reducing bushings, a coupling and a piece of tubular glass. Most reducing bushings have an unthreaded recess on the inside, the threads not extending entirely through, which affords an excellent shoulder for retaining the glass at both ends. A hole is drilled through the coupling of approximately the same size as the outside diameter of the glass. The two bushings can be screwed firmly down into the coupling and the distance measured, which will give the necessary length for the glass. The glass can be set with cement or putty.



OIL-CUP SIGHT FEED MADE OF PIPE FITTINGS

Where a new fitting cannot be secured or a cup having no sight feed is used, this little kink can be resorted to and will afford a strong and easily constructed sight feed. The one shown is of a $\frac{3}{4}$-in. coupling for $\frac{1}{2}$-in. connections, a short piece of $\frac{3}{8}$-in. lubricator glass being set in place with cement.

Operation and Maintenance of Elevators—Care and Lubrication

By R. H. WHITEHEAD

Attention is called to the fact that elevator machinery, like any other equipment, must be given proper care. Certain important features in the maintenance, care and lubrication of modern drum-type elevator machines are pointed out.

EVERY operating engineer knows the necessity of careful maintenance of machinery to avoid trouble and get the proper results. The writer finds that elevator machinery is very likely to be neglected. Sometimes this is because the elevator is cared for only when there is nothing else to do and this happens at infrequent intervals, and in other cases it is due to lack of familiarity with the equipment. The only

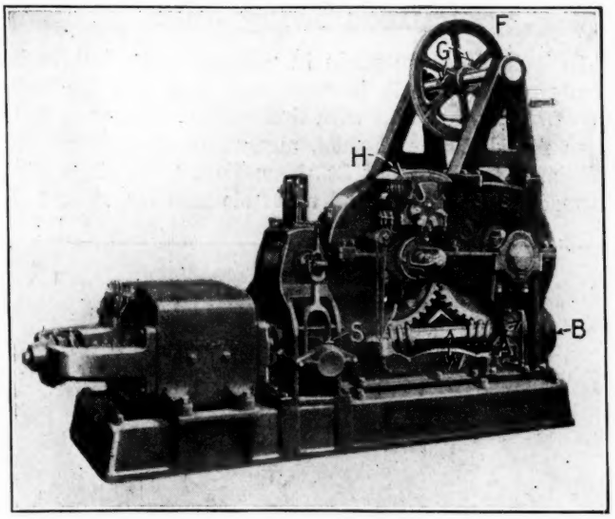


FIG. 1. DOUBLE-GEARED ELEVATOR MACHINE

proper way to maintain an elevator is to make thorough inspections of the various parts of the installation at regular intervals. Several elevator manufacturers furnish just such service on what is termed a "Maintenance Contract." In the following, attention is called to certain features in the maintenance and care of the drum type of elevators.

1. Open the main-line switch and take care that no one closes it, so as to prevent accidents when preparing to clean, oil or repair any part of the machinery. Keep all parts of the machine and controlling device, motor room and pit clean; a pair of hand-bellows should be used to blow the dust from the motor, controller and other parts of the apparatus that cannot be conveniently reached. Where possible, the parts should be wiped clean, and cement and brick dust not allowed to get on the machinery and into the lubricants.

2. Self-oiling motor bearings have rings, which should always turn freely, and the oil chambers must be kept sufficiently full of motor-bearing oil to insure the oil rings dipping into it. Attention should be given the rings while the machine is running to see that they carry the lubricant from the oil well to the top of the shaft.

3. Use only worm-gear lubricant for the worm and gear and keep the gear case filled to a point just above the top of the wormshaft *W*, Fig. 1; the standpipe *A* on the side of the gear case should be used to determine the height of the oil. To remove sediment and grit, drain the oil from the gear case three or four times a year and refill with fresh lubricant. If the oil gets below the wormshaft level, the bearings will seize and expensive repairs will be necessitated. Do not use dirty or poor lubricant, as the worm and wormwheel will wear quickly, and for that reason it is poor economy.

4. The wormshaft bearings *B* and *B*, Figs. 1 and 2, are automatically oiled from the gear case, and oil should be allowed to drip slowly through the wormshaft gland *C*, Fig. 2, to insure perfect lubrication of the inboard bearing. Use a pan to catch the oil, but do not use the oil again without straining and then only once.

5. The wormshaft stuffing-box *D*, Fig. 2, must be kept packed with square-braided flax packing. The gland-adjusting nuts *E* must be tightened evenly to prevent

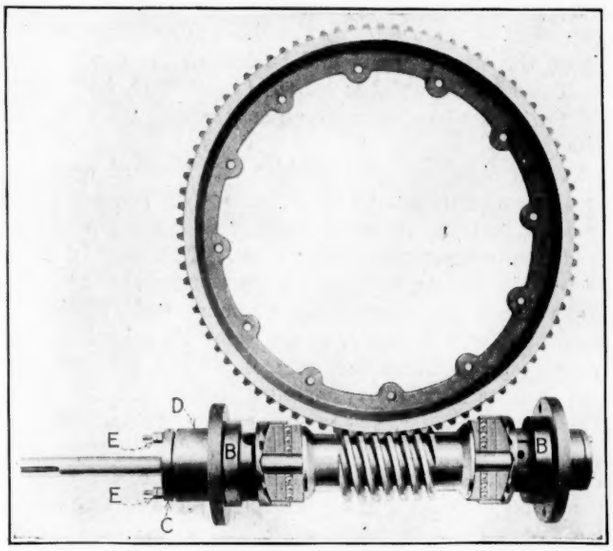


FIG. 2. SINGLE WORM AND GEAR SHOWING BALL THRUST BEARING

binding of the wormshaft, but not tight enough to prevent the drip of oil.

6. Drumshaft bearings should be lubricated every day or be provided with automatic grease cups or lubricators.

7. All parts of the governor must be kept well lubricated so that they work freely and easily, and this includes the tension sheave in the pit.

8. Vibrator sheaves *F*, Fig. 1, should be lubricated by means of grease cups *G* filled with compression-cup grease and sufficiently compressed to properly feed the lubricant. If automatic grease cups are used, be sure

that the cups feed. Remove the entire cup occasionally and see that grease feeds slowly through its nipple.

9. Overhead-sheave bearing boxes should always be packed with compression-cup grease. The grease must be pushed against the shaft once or twice a week, as sufficient heat is not generated in the bearings to cause the grease to run as in the case of continuously operated machinery.

10. Ropes should occasionally be coated with elevator-rope compound to preserve them and prevent rusting. This may conveniently be applied with a brush.

11. Safety devices on the car frame and safety plank under the car should be examined at frequent intervals and all working parts kept clean, well lubricated and free from rust.

12. On the guides use guide lubricant and occasionally clean down the guides with kerosene to remove grit. If lubricators are used, see that they are kept clean and filled.

13. Adjust the brake springs *S*, Fig. 1, to properly hold the car under maximum load and to give a smooth stop. Set the brake shoes so that they just clear the brake drum when released. If a piece of thin paper can be passed between the shoes and brake drum, the clearance is sufficient. In case the clearance of the brake shoes is too great, they should be reset to give the proper lift. The brake drum and brake shoes must be kept dry and clean. Under no circumstances allow oil on the brake drum or brake-shoe lining. In the case of an alternating-current machine the brake-magnet case must be kept well filled with brake-magnet oil. When necessary to remove the brake shoes for cleaning or repairs, the empty car should be left at the top landing with the counterweights securely blocked up in the pit. Oil the brake-lever pins frequently where oil holes are provided.

14. On direct-current machines, to prevent sparking at the commutator, when adjusting or renewing the brushes, fit them to a full bearing with a strip of fine sandpaper—never use emery cloth. This may be done by placing the paper between the commutator and the brush (sand side against the carbons) and drawing it back and forth by hand, at the same time keeping the smooth side against the surface of the commutator. The carbons must always project beyond the holder so that the latter will not bear on the commutator. Brushes should be staggered to distribute wear evenly on the commutator. In case the commutator becomes rough, it may be made smooth by holding a piece of fine sandpaper—never emery cloth—against the surface while the machine is running, after which it should be wiped clean. A canvas pad—never use waste—should always be used for cleaning the commutator. Sandpapering the commutator should be avoided as much as possible. Polishing when new with canvas, after being sure that the brushes do not spark and are bearing properly on the commutator, brings about the burnished finish which renders the commutator less liable to damage.

It is most essential to keep the commutator free from dirt and oils. This applies to the head of the commutator and the mica insulating ring at the base of the bars, as well as to the surface of a commutator.

On alternating-current machines keep the collector rings on the motor clean and free from dirt and oil and see that all brushes have a good even bearing on rings.

15. The contacts of the slack-rope switch and of the hatchway-limit switches should be frequently cleaned.

16. The car should be frequently tried on the atuomatic stop to see if it is properly adjusted, as the automatic is thrown out of adjustment through the stretching of the ropes. Frequently remove the cover *H*, Fig. 1, of the automatic switch on the machine and clean the contacts thoroughly and oil its mechanism.

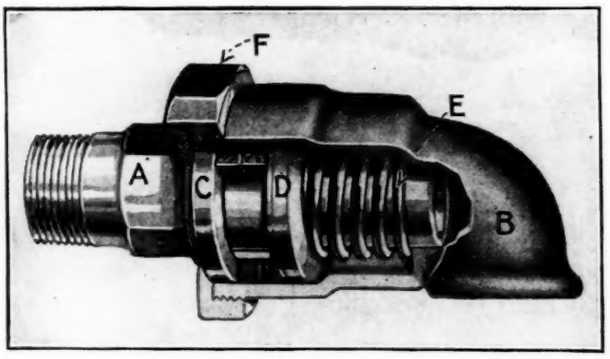
17. The ropes should be shortened as may become necessary and never allowed to lengthen to such an extent that the car will not open the hoistway-limit switch at the top of the hoistway before the counterweights bottom in the pit.

18. Controller parts should be kept clean and well lubricated so that they work freely. Keep the metal and carbon contacts on the controller clean and free from pits and blisters. They should be frequently dressed with sandpaper and have a good even bearing when in contact.

Although the foregoing was written as applying to Otis Elevator Co.'s machines, nevertheless the major portion of it applies to elevator machinery in general.

Tuxeda Swing Joint

Swing joints are made in various types, but to be really serviceable it is necessary that they be leak-proof. A swing joint with this quality appears to have been found in the Tuxeda, manufactured by Franklin Williams, 39 Cortlandt St., New York City. The joint is made with a male and a female member, *A* and *B*.



SEMI-INTERIOR VIEW OF TUXEDA SWING JOINT

The male member has a collar *C* against which the packing is forced by the pressure exerted upon the loose collar *D* by the compressed spring *E*, as shown in the illustration. The joint is held together by a shoulder nut *F*, which screws on the outside of the *B* member. The spring *E* automatically compensates for wear of the packing and keeps the joint tight. When worn out, the packing is easily removed and replaced. This joint is made in standard sizes from ⅛ to 3 in., but larger sizes are available.

Water Commissioner George C. Andrews of Buffalo, N. Y., reports that during the month of April, water pumpage was reduced millions of gallons with a saving of 415 tons of coal, worth $1850. Pitometer experts have been at work searching for underground leaks which do not show on the surface of the streets. Several large leaks have been located and repaired.

Pipe-Line Transportation of Coal

Some of the chief features of a proposed plan for increasing the transportation facilities of the United States, preventing fuel famines, and saving a billion dollars a year.

THE pressing necessity for an ample supply of coal to meet the greatly augmented demands of the war industries and at the same time provide for all normal requirements in the matter of heating, lighting and power has focused an extraordinary amount of attention on the present-day methods of distributing and utilizing fuel. As a result, numerous schemes have been suggested with a view to eliminating wasted effort and thus ameliorating the difficulties that at present confront the coal consumer.

One of the most ambitious of these plans is that proposed by Farley G. Clark, of Niagara Falls, N. Y. Although it relates specifically to bituminous coal, its application would save both hard and soft coal and would relieve the railroad situation, at the same time producing a stupendous saving of money. The plan contemplates:

1. The preparation of bituminous coal at the mines by pulverizing and the removal of a large part of the impurities by washing.
2. The transportation of the prepared coal mixed with water through pipes laid along railroad lines.
3. The storage of such coal in quantity, properly protected against deterioration, near the centers where it is to be used.
4. The utilization of pulverized coal in locomotives, for steam generation and for general use.
5. The manufacture of byproduct coke and gas at or near large metropolitan districts, the coke to be used in metallurgical processes and mixed with pulverized coal and tar as briquets to replace anthracite, and the gas to replace soft coal, water gas and anthracite.

Use of Water To Flush Coal Through Pipes

The chief feature of this scheme is the pumping of the prepared coal through pipe lines from the mines to centers of distribution. Water is used as the vehicle for carrying the coal, because it is cheap and abundant. The coal as it comes from the mine is sent through crushers, in which it is reduced to ¾-in. lumps, and then passes by gravity to the pulverizers, in which it is reduced to such a fineness that all of it will pass through 100-mesh and 50 per cent. through 200-mesh.

Magnetic and gravity separators remove impurities and the coal is then run into jiggers, in which it is thoroughly agitated with water, resulting in the dissolving of most of the sulphur and some of the other impurities. Centrifugal separators then remove most of the water, and the fairly dry coal is washed and delivered to wet grinders, from which it issues as a slime. The slime passes over concentrating tables, where it is divided into two grades, one to be sent to the boiler room for immediate use and the other to be sent to the pipe-line pumps.

The slime to be pumped is mixed with fresh water in agitating tanks, from which it is drawn by centrifugal pumps and forced through the pipe lines. The mixture in the pipes consists of from 30 to 40 per cent. of water and from 57 to 67 per cent. of coal, the remainder being ash and other foreign matter. The entire cost of this preparation will not increase the cost of the coal more than $1 a ton in extreme cases, and in some cases only about 25c. a ton.

The pipe lines are run along the rights-of-way of the railroads and are placed underground wherever possible. The main lines are supplied by branch feeders from the producing centers and branch distributors lead off to the distribution centers. A network of such pipe lines, with suitable storage reservoirs, coke ovens and briquetting plants would handle 70 per cent. of all the bituminous coal mined.

Pumping Stations and Storage Reservoirs

Pumping stations at intervals of 12 miles or more would need to be provided on the main pipe lines, and at each station an emergency reservoir would have to be supplied to allow the pipe line to be drained to prevent freezing or to make repairs. At the distribution plants it would be necessary to have large storage reservoirs, one for each grade of coal pumped. These accumulations would tide over any reasonable emergency that might arise and would enable a demand for a certain grade to be met immediately.

At or near the distributing plants the byproduct coke ovens or coal-gas plants would be erected. These would convert the coal sludge into coke and gas and recover the usual byproducts. The gas would be piped through mains to supply the district. The coke would be shipped to foundries and furnaces, while the breeze could be mixed with pulverized coal and briquetted.

It is estimated that the cost of pumping the coal would be comparatively low. A pipe line 20 in. in diameter would handle 25,000 tons per day at a cost of 50c. per 1000 ton-miles of actual coal transported, this figure including operation, maintenance and 10 per cent. interest on investment. The present rate for transporting coal by car is more than $4 per 1000 ton-miles.

Mr. Clark's plan does not contemplate the immediate changing over of all boiler plants so as to use dry pulverized coal. That is considered as a possibility to be reached eventually. For the present the pipe-line coal would be used in boiler furnaces as they exist or as they could readily be adjusted without seriously disturbing industries. The coal would be deprived of moisture to 10 per cent. or less by centrifugal driers and spread over the grate by suitable devices; or, it may be burned by the existing types of underfeed and chain-grate stokers. The moisture remaining in the coal will hold the fine particles together until the volatile matter is driven off and the coke remains. As there is very little ash or impurity in the fine coal, the tendency to clinker will be practically eliminated. The ash in pipe-line coal would never exceed 3 per cent. and the average would be much lower.

The railroads distribute over 80 per cent. of all coal and this constitutes 35 per cent. of the total freight handled. The pipe-line distribution of coal would re-

duce the freight congestion on the railroads by relieving them of at least one-fourth of their present burden, thus enabling the equipment to be used for other commodities.

The greater part of the domestic coal consumed is anthracite. Under the pipe-line system, heating and cooking would be carried on largely by the use of gas from coke ovens and gas plants burning pulverized coal, supplemented by the use of briquets and anthracite, with a resultant enormous saving.

The estimated saving in tons of coal in various lines is given in Table I, and the value of the saving is given in Table II.

TABLE I. ESTIMATE OF COAL SAVING

	Used in 1917 Millions of Tons			Possible Saving Millions of Tons		
	Bit.	Anth.	Total	Bit.	Anth.	Total
Railroad	180	5	185	100	3	103
Steam	195	20	215	20	15	35
Coke	75	...	75	—45	...	—45
Domestic	25	45	70	20	35	55
Export	25	5	30	5	...	5
Bunker	20	...	20	...	...	...
Miscellaneous	20	5	25	5	...	5
Totals	540	80	620	105	53	158
Per cent. saved				17.4	66.2	25.4

TABLE II. VALUE OF COAL SAVING

Bituminous railroad coal, 100 million tons at $4	$400,000,000
Bituminous general-use coal, 5 million tons at $6	30,000,000
Anthracite railroad coal, 3 million tons at $3½	10,000,000
Anthracite general-use coal, 50 million tons at $8	400,000,000
Total	$840,000,000
Substituting $6 coal for oil at $4 per bbl., saving $2 per bbl., on 20 million bbl	40,000,000
Substituting byproduct for coal and water gas, saving 25c. per 1,000 cu.ft. on 800 billion cu.ft	200,000,000
Total value of saving per year	$1,080,000,000

This saving of over a billion dollars a year is necessarily only an estimate, but it is based on conditions with regard to which reasonable predictions can be made. Moreover, it does not take into account the relief to the railroads and to industry in general, while the value of storage at the points of consumption cannot be reduced to dollars.

In developing his idea, Mr. Clark has counted on objections from various quarters. For example, mine workers and owners may find fault with some provisions of the scheme, particularly those that relate to the recovery of a greater percentage of the coal from the earth, even at the risk of including more dirt, since the subsequent washing and grinding removes the impurities.

Objections From Railroads and Others

The railroads may be expected to object to a change that would remove a large part of their freight business; but with the increased demand for transportation of other materials than coal, it would seem as though the net result would be to the advantage rather than the disadvantage of the railroads.

The coke industry might interpose some objections, because the Clark plan contemplates the use of byproduct ovens only, and the obliteration of the beehive type. Some engineering objections might be raised in connection with the utilization of pipe-line coal, but it is believed that there are no obstacles of an engineering character that cannot be overcome.

Of course, the complete adoption of a plan of this magnitude would cause considerable change in the methods of utilizing coal, and expense would be incurred; but for the sake of so great a saving, it would be proper to go to considerable initial outlay. The fuel problem must be settled sooner or later, for it grows more acute each year, and such plans as the one proposed by Mr. Clark indicate a healthy interest in the solution of this important matter.

Superheat in Forced-Draft Stoker Installations

By H. R. Greene

In designing boiler plants, as in the case of all engineering installations, there must be taken into consideration by the engineer, the relation between the first cost of the various apparatus and their performances. Coal is much more expensive than formerly and, unquestionably, in this country within a short period of time we shall be compelled to select all the component apparatus with a view to the highest efficiency in the production of power in the complete installation. This being the case, it is axiomatic that the economical performance of various apparatus is, except in extreme cases of excessive cost and where certain predetermined performances must result regardless of economical operation, the determining factor in the decision as to selection.

In the competitive-sales problem of multiple-retort stokers, the economical operation of the necessary auxiliaries is of the greatest importance in determining the advisability of selection in comparison with natural-draft stokers. This is necessary to justify the high first cost of the former and also the excessive additional expense of the forced-draft equipment to supply air for predetermined results exclusive of the higher combined efficiencies obtained and the net economical results of the boiler-stoker combination. In the large power stations where great fluctuations of load occur, the forced-draft system of air supply must always prevail, on account of the elasticity required, but in manufacturing plants operating under nonvariable loads, the sales problem becomes one of comparative efficiency, all things being taken into consideration.

Here is where superheating is of value. We may compare the steam necessary for stoker driving as about equal between the forced- and natural-draft systems; but all the steam necessary for the forced-draft equipment must be charged against the efficiency of the stoker requiring it. Superheating is, of course, raising the heat of saturated steam above the temperature normal to its pressure. We then have a gaseous element, following the laws of perfect gases, and no moisture can exist while superheat remains; thus pipe and cylinder condensation losses are eliminated.

The problems of proper packing and lubrication in reciprocating engines have been largely solved, and with turbines lubrication is not necessary and packing complications have been satisfactorily overcome.

As we use both turbines and simple engines for fan prime movers and the latter for stoker driving also, it is interesting to note that the saving in the former at 100 deg. F. superheat would reach approximately 8 to 10 per cent. and in the latter over 12 per cent. The importance of such savings in water rates can readily be realized in computing comparative net efficiencies with natural-draft stokers in competition.

Useful Kinks for Engineers

By Frank R. Williams

The so-called self-marking paper for indicator diagrams and other uses is a plain chemically coated paper that is easily marked by the touch of a plain brass or aluminum point. It is much used for taking indicator diagrams instead of the common paper card and lead pencil, which are often troublesome and unsatisfactory. The paper can be bought in large sheets or it may be prepared easily and cheaply at home as wanted, by taking ordinary zinc white, which can be bought at any drug store or paint shop, and mixing with common thin mucilage into a thin paint and lightly coating the paper with it. When dry it may be used as ordinary indicator-card paper, using a brass or aluminum point instead of a lead pencil.

It is often desirable to make holes in glass, but few persons know how to do this. It may be done easily and conveniently without special appliances in the following manner: For small holes take an ordinary three-cornered file, such as is used for sharpening saws, and grind all flat sides to a three-cornered sharp point. Then put some spirits of turpentine on the glass and rotate the drill with a moderate pressure. One will be surprised at the slow but satisfactory progress that will be made through the glass. The cutting edge of the drill should be kept wet with turpentine while cutting. The old receipt says add camphor dissolved in spirits of turpentine; but I find that the drill works well without the camphor.

To make large holes, take a copper tube the size desired and rotate it upon the glass with moderate pressure, and keep it wet with fine emery and oil. It is best to cut from both sides, meeting in the center, but one should be careful to keep the drills rotating freely and easily, as any pinch or jam may break the glass. Finish the hole with a half-round file wet with spirits of turpentine.

An ordinary twist drill can be used to drill glass, but it must be ground with considerable clearance, both on the cutting edge and on the circumference, as the least pinch will break the glass. Keep the drill wet with spirits of turpentine.

Engineers do more or less soldering, and a strong solder can be had by using pure tin. It will be about twice as strong as common tin and lead solder and never turns black or disintegrates. I have used it exclusively, where greater strength is required than is obtained with ordinary solder and where brazing or silver solder would not do because of the high temperature.

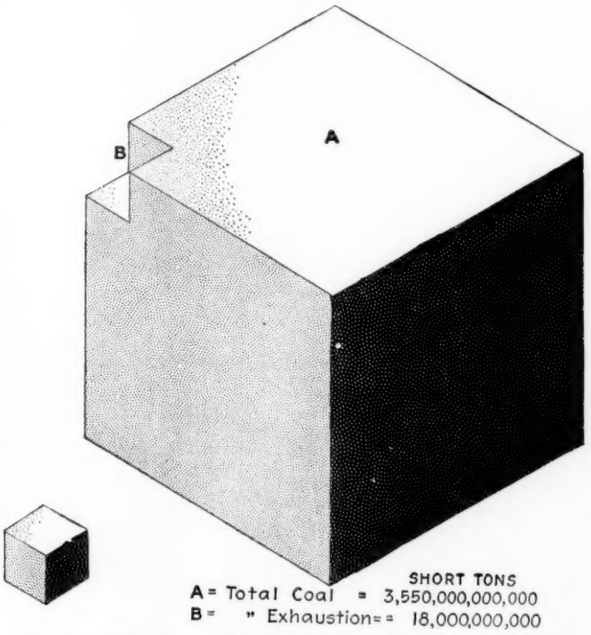
A safe liquid flux for electrical soldering is made by dissolving rosin in alcohol. A similar paste flux is made by taking chloride of zinc, which can be bought at any drug store, and rubbing it into a thick paste with common vaseline or petrolatum.

Worn or warped rubber valves may be refaced and made to do additional duty by tacking a sheet of sandpaper on a smooth board and, with the hands holding the valve flat and steady on the sandpaper with gentle pressure, rubbing the valve back and forth. This will gradually cut down the rubber so as to make a true face.

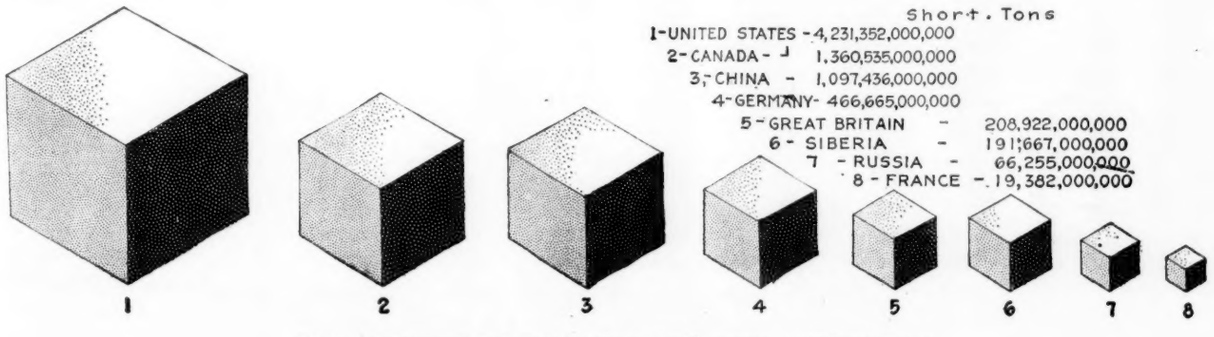
To remove broken taps or drills, wet for a few hours with ordinary muriatic acid which will slightly dissolve the steel and make the broken tool smaller, thus making it more easily removable.

The Coal Supply

The illustrations below are from a paper by R. H. Fernald before the Engineers' Club of Philadelphia. With their aid one is able to visualize the coal supply of the world and to get a good conception of the coal available in the United States compared with what has been used up to date.



TOTAL AVAILABLE COAL IN UNITED STATES AND EXHAUSTION TO CLOSE OF 1917



COAL RESERVES OF THE WORLD AND THEIR DISTRIBUTION

Plastic Refractory Boiler Baffles

The principal loss of heat from a boiler furnace is in the flue gases, and is measured by the product of their weight, specific heat and excess of temperature over atmospheric. High temperature of gases may be due to their coming in contact with too little heating surface, to coatings of soot or scale on the heating surface which prevent the absorption of heat from the gases, but most commonly it is caused by defects in the baffling.

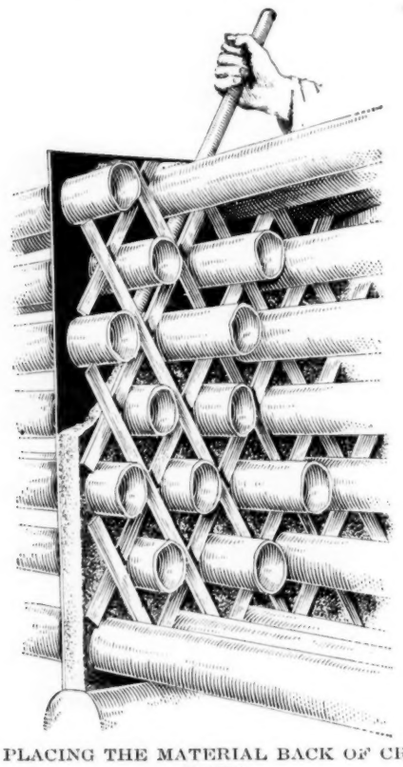


FIG. 1. PLACING THE MATERIAL BACK OF CRISSCROSS SLATS

Baffles may be improperly located, producing dead spaces where the gases do not circulate in the tube banks of water-tube boilers, or the baffling may not provide for a sufficiently high velocity and long path of the gases of combustion.

Defective baffling is the most common cause of high chimney temperatures. The baffles may have fallen down, or bricks or blocks may have slipped out from between the boiler tubes, allowing the short-circuiting of a large amount of gas.

Baffles for water-tube boilers have in the past consisted of tile, bricks or blocks of refractory material fitted in between the tubes. In cross-baffled boilers these tiles are introduced between the tubes by springing the latter, and naturally do not always form tight joints with one another or with the tubes, especially after the latter have warped or sprung, as they invariably do in service. It is also difficult to insure that blocks will remain where they are placed and will not slip or fall, leaving large openings. Owing to the manner in which baffles are inserted in boilers, it is almost impossible to cement them together; moreover, the difference in expansion and contraction of the boiler and baffling would break the joints apart.

The illustrations show how jointless, gas-tight baffles can be made by the use of a refractory known as plastic firebrick and manufactured by the Betson Plastic Fire Brick Co., of Rome, N. Y. This material is compounded of refractory substances so prepared as to practically eliminate expansion and contraction with changes in temperature.

In forming a cross-baffle for a water-tube boiler of the B. & W. type, the ordinary cast-iron baffle plate is used as one side of the mold, while the other is made by thrusting slats in through the diagonals between the tubes, as shown in Fig. 1. The plastic material is then poked down through the diagonals to fill the space between the cast-iron baffle plate and these slats. It is sufficiently plastic so that it can be forced out sidewise around the tubes, fitting the latter snugly.

When this work has been completed, the boiler is fired up slowly, the crisscross of slats burns out, and the plastic material is dried and vitrified in place. This operation occupies only a few hours, after which the full load may be put upon the boiler. Inasmuch as the boiler comes up to full steam pressure before the material is thoroughly set, the expansion of the metal pushes away the soft material to the position it should occupy when the boiler is hot, and while the boiler will draw away from the material in cooling off again, the baffles will fit tightly when the boiler is under steam.

In forming a longitudinal baffle, Fig. 2, blocks of wood are placed in between the tubes, above and below the space which it is desired that the baffle shall occupy, thus confining the plastic material, which is shoved in from the side in the case of baffles in the middle of the tube bank or from underneath or overhead in the case of the baffles at the bottom or top of the tube bank.

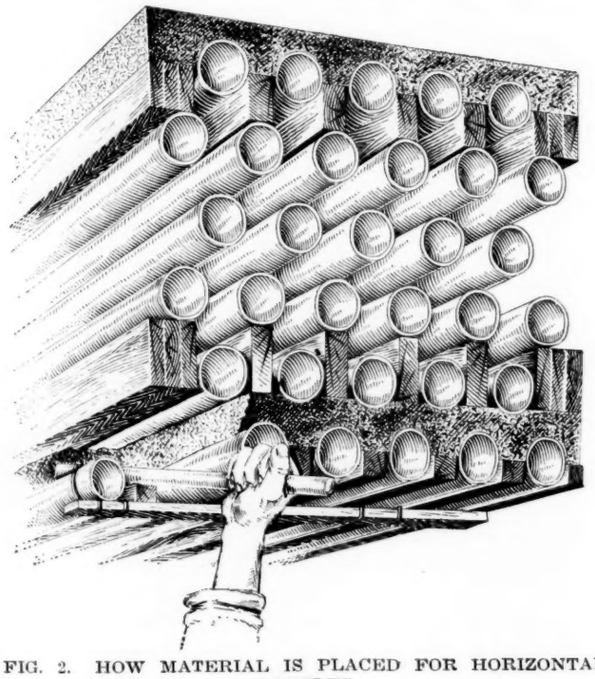


FIG. 2. HOW MATERIAL IS PLACED FOR HORIZONTAL BAFFLES

Where this material is used, there is no restriction upon the shape or size of the baffle, and the latter can therefore be arranged in any form desired. In cross-baffled boilers, for example, it is becoming the practice to slope or incline the baffles so that the gas

passage will contract progressively from the point where the gases enter the tube to the point where they leave, in order to maintain a uniform gas velocity, in spite of the shrinkage of gas volume with cooling. This is easily accomplished with the plastic material.

This material also finds use as a substitute for special forms of bricks or blocks; as for example, where the front headers of horizontal water-tube boilers rest upon the front arch. It is used for lining furnace and combustion chambers, including front arch, side walls, bridge-wall, rear arch, etc.

Refinite Water Softener

When boiler-feed water contains a scale-forming element, two conditions must be met—the boiler shell and tubes will have to be cleaned of scale at intervals, according to the quantity of scale formed, and if the formation is to be prevented the water must be treated before it goes into the boiler.

Numerous systems of water-softening plants are employed for boiler-feed water, some being installations of considerable size, and are generally used with steam plants of medium and large capacity. A system designed for both small- and large-capacity power plants is manufactured by the Refinite Co., Omaha, Neb., and is known as the Refinite water softener.

The illustration shows a 60-in. water-softener system, consisting of a closed tank in which the softening mineral bed of filter gravel is placed. Raw water enters the softener tank through the pipes *A* and *B* and, striking a baffle plate, is sprayed over the mineral softening bed. The treated water leaves the softener through the pipe and meter *C* after it has passed through the Refinite mineral bed.

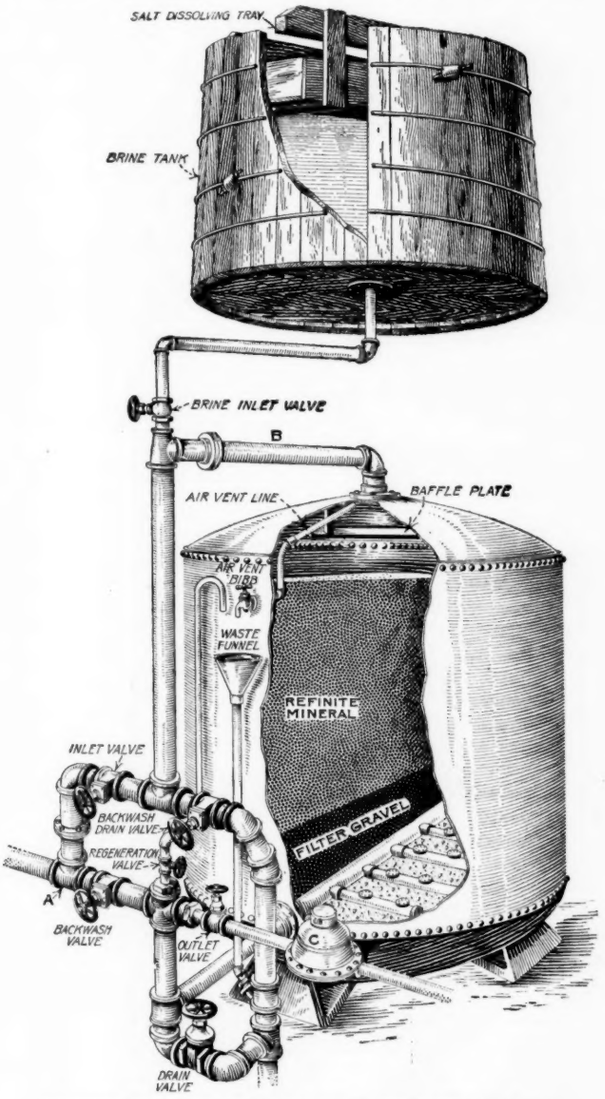
The operation of the system depends upon this mineral bed, which is composed of a clay product having zeolite properties. It is put out in a form suitable for the commercial use of softening water, and the mineral is furnished with the apparatus, which, as shown, is constructed much the same as the ordinary pressure filter. The mechanical operation of softening water is one of simple filtration, or just passing the water through the mineral bed, the same as water is passed through a sand filter. After a time all the original sodium in the Refinite will have been given up in this exchange. When this occurs, the softening action ceases, but it is not necessary to replace the mineral or to remove it from the softener container.

By a reverse action, called regeneration, in which ordinary salt is the reagent, the softening action of the Refinite may be restored. Common salt, sodium chloride, is dissolved in water in a tank, and the brine run into the softener and allowed to stand therein for a few hours, after which the softener is ready for the next run.

Hardening salts in water vary considerably, and can be actually determined and weighed. A pound of Refinite mineral has the ability to take up a certain amount of these hardening salts by actual weight. Therefore, the capacity of one pound of the mineral in gallons would depend on the weight of the hardening salts in the total quantity of water handled.

One pound of Refinite mineral has the ability to take up 54 grains of hardness. If the water contains 18 grains per gallon, one pound of Refinite mineral will handle three gallons, and the time required for the action is ten hours. From three-fourths of a pound to one pound of salt is required to eliminate each grain of hardness in a thousand gallons of water by the Refinite process. If the water contains 18 grains of hardness, for instance, 18 lb. of salt would be required to treat 1000 gal. The average cost of the salt used is about a half-cent per pound.

Thus the capacity of any sized softener in which a stipulated amount of mineral is used, depends on the



SEMISECTIONAL VIEW OF THE REFINITE WATER SOFTENER

hardness of the water treated. If the water is 18 grains hard, a certain number of gallons can be handled. If the water is only 9 grains hard, twice the amount can be handled, and the capacity in any case is inversely proportional to the hardness in the water.

It is necessary, therefore, to regenerate after each capacity of softening has been run. If the machine is designed to handle 10,000 gal. in 10 hours, it is regenerated after each 10-hour run, and the time required for regeneration is usually from 8 to 10 hours. The operation takes place at night while the softener is not in operation.

Questionnaire Which Owners of Power Plants Will

Questionnaire for Power Plants. General Information To Be Supplied by the Owners. Not to Be Used for the Rating of Plant

Date of Report.....

Name of company, concern or owner.....

Address of Central Office.....

Name and location of plant inspected.....

Character of product or service.....

Stationary Boilers

WATER-TUBE BOILERS

Number	Hp.	Kind of Draft			How Fired		Total Hp.	Remarks
		Nat'l	Forced	Induced	Stoker	Hand		

FIRE-TUBE BOILERS

Number	Hp.	Kind of Draft			How Fired		Total Hp.	Remarks
		Nat'l	Forced	Induced	Stoker	Hand		

Movable Boilers*

Number	Hp.	Type	Remarks

* In the rating of the plant movable boilers will be considered separately. The questionnaire does not call for information regarding movable boilers except as per above table. The influence of movable boilers on the rating of the plant will be left to the judgment of the Administrative Engineer.

Kind of coal..... Bituminous Semibituminous Anthracite

Size.....

Tons of coal of 2000 lb. used during twelve months ending May 1, 1918.....

Months of operation of plant during the same year.....

Approximately what percentage of live steam is used for:

	Winter Per Cent.	Summer Per Cent.
(a) Making power		
(b) Heating building		
(c) Process work		

Is purchased electric power used? .....

If so, how many kilowatt-hours consumed during twelve months ending May 1, 1918? .....

Records

Are records kept to show any of the following information? Answer "Yes" or "No" in table.

	By Shift	Daily	Weekly	Monthly
Water evaporated by boilers				
Coal consumed by boilers				
Flue gas analysis				
Electrical output or consumption kw.-hr				

Engine Equipment

STEAM UNITS—ENGINES, TURBINES, PUMPS

Type	No.	Initial Pressure	Rating		Condensing	Noncondensing	Type of Valve Gear
			Hp.	Kw. or Gal. Per Min.			
Simple.....							
Compound...							
Turbine.....							
Steam Pumps.							

What changes have you in progress which are expected to reduce your fuel consumption?

.....

When will they be in effect?

.....

Further remarks by owner:

.....

Note to Owner: If sufficient space is not available in the questionnaire, please attach an extra sheet with the additional information.

Recommendations by the Fuel Administration

That provision be made for weighing and recording of the fuel used each shift or day.

That feed water be heated and measured.

That provision be made for an adequate supply of air to the fuel and convenient means provided for the measurement and control of the draft.

That provision be made to keep boiler surfaces clean inside and out.

That the grates be in good repair, that settings, breeching and access doors be free from air leakage, and that boiler surfaces wasting heat be covered with insulation.

That the surfaces of steam piping, drums and feedwater heaters which waste heat or steam by radiation be properly covered with insulating material.

That exhaust steam be utilized wherever possible, to the exclusion of direct steam from the boilers. The plant should be so designed that no more exhaust steam will be produced than can be efficiently utilized in heating or process work.

That a competent man in the plant be detailed for the work of fuel conservation in the boiler and engine rooms.

That a competent man or committee be detailed for the work of fuel conservation in the building or shop outside of the power plant.

Be Asked by the Fuel Administration to Fill Out

Outline of Standard Questionnaire Covering Operation of Steam-Power Plants. Questions to Be Marked to Form Basis of Rating of Plant

(a) FUEL: Value of question, 9. Mark rec'd.....

Question 1. What provision is made for weighing fuel used each shift or day?

Question 2. What records are made of fuel used each shift or day?

Question 3. What grate surface is in use each shift, exclusive of banked fires?

Question 4. Total coal used each shift exclusive of banked fires?

(b) WATER: Value of question, 15. Mark rec'd.....

Question 1. What provision is made for heating and continuous measuring of feed water (check answer in table below)?

Heating	Means Used for Measuring
Open feed-water heater	
Closed feed-water heater	
Exhaust steam	
Direct steam	
Waste heat economizer	

(c) AIR SUPPLY: Value of question, 12. Mark received .....

Question 1. Are means provided for measuring the draft over the fire?

Question 2. Are means provided for determining the excess air by flue-gas analysis?

Question 3. Are dampers provided for equalizing the draft in the furnaces?

Question 4. Is there a convenient means for regulating the draft by main or uptake damper?

Question 5. Is there an automatic damper regulator in working order?

(d) CLEAN HEATING SURFACES: Value of question, 12. Mark received .....

Question 1. What provision is made for keeping soot and ashes from boiler-heating surfaces (mark answer in table below)?

Steam lance for blowing soot by hand		
Mechanical soot blower		
Brushes or scrapers		

Question 2. How often are the soot and ash cleaned from the boiler-heating surface?

Question 3. What provision is made for keeping scale and sediment out of the boiler (check answer in table below)?

Chemical treatment of feed water in the boiler		
Chemical treatment of feed water outside of boiler		
Filtration of feed water in open feed-water heater		
Filtration by means of feed-water pressure filter		
Other means		
Water is free from scale or sediment without treatment		

Question 4. What means are used for removing scale from the boiler?

Hand..... Mechanical.....

(e) BOILER AND FURNACE SETTING: Value of question, 20. Mark received.....

Question 1. Are the grates warped, broken or otherwise defective?

Question 2. Check air leaks observed, as follows:

Leaks in boiler setting		
Openings between boiler and setting		
Badly warped fire-doors		
Badly warped cleaning or access doors		
Leaks around blowoff piping		

(f) INSULATION: Value of question, 7. Mark received .....

Check any of the following items where saving could be made by covering surfaces with insulation:

Exposed drums of boilers	
Exposed shells of boilers	
Steam piping in boiler room	
Steam piping in engine room	
Feed-water heater	
Exhaust-steam piping where fuel could be conserved by covering	
Feed lines	

(g) ENGINE-ROOM AND HEATING SYSTEMS: Value of question, 15. Mark received.....

Question 1. Is exhaust steam used: Entirely..... partly.....not used?.....

Question 2. State service for which this steam is employed: Heating.....Cooking..... Dry room.....Tank heating.....Low-pressure turbines..... Other purposes .....

Question 3. Is there an excess of exhaust over requirements?

	Day	Night
Winter		
Summer		

Question 4. Is there any low-pressure live steam used in the plant?.....At what pressure? ....lb. gage. For what purpose?..... Heating..... Cooking.....Dry room ..... Tank heating..... Other purposes.....

(h) SUPERVISION: Value of question, 10. Mark received .....

Question 1. Has the owner detailed a competent employee to supervise the work of fuel conservation in the boiler and engine plants with directions to report weekly on measures for economy and progress in conservation of fuel?
Name and title of this employee

.....

.....

.....

Question 2. Has the owner appointed a man in charge of the work of fuel conservation outside of the boiler and engine rooms described under Recommendations?
Name and title of this employee

.....

.....

.....

Let's "Can" the Bellyache*

This country—your country, our country—is at war. Let's cut out the bellyache.

We are at war with a powerful, relentless foe—a foe lusting for dominion. We are at war to save our own "hide"—our own individual hides.

By "making the world safe for democracy," we are making it "a decent place to live in"—for you and yours and me and mine. We are at war to perpetuate those things that stand for *our own* daily happiness. Let's not forget that. We're in this thing in self-defense. So, let's "can" the bellyache.

There are a few people who think this war isn't worth while, and most of them are keeping their mouths discreetly shut. But there are a host of flyspeckers, calamity howlers, and woe-betiders that are barnacles on the Ship of State. At heart most of them are loyal, good American citizens, but their tongues are loose. If you think this war is worth while, then join a movement to stop the mouths of those sobbers. Let's "can" the bellyache.

Our sympathy goes out to the man whose business has been hit a hard wallop by this war. We are sorry for the man who can't get cars; can't borrow money; can't ship goods, or can't make 'em. We are sincerely sorry to see a man suffer, even when his suffering may be necessary to further the chief business in which we are all engaged—the business of winning the war.

Let's "can" the bellyache.

If our public servants are sometimes wrong; if they misjudge conditions, men, measures, then those who suffer unjustly—while the nation trains off its fat and girds itself for war—let those with a common grievance get together, do some constructive thinking and planning and show our public servants, not with sobs and whines, but constructively, how things should be done. Let's cut out the fault-finding. "Can" the bellyache.

There are four things worth having in mind all the time:

1. The seriousness of the war—the necessity that it be prosecuted as the chief activity of the nation, at the cost of individual needs and preferences.

2. The fallibility of all men and, therefore, all public servants; the unescapable fact that no man or body of men could run even a *little* war and please everybody—and this war is the biggest war the world has ever seen.

3. The fact that our Government recognizes the necessity that business proceed so that the difference between income and outgo shall be as great as possible on the credit side—so that there may be profits and savings out of which to pay for the war.

4. The fact that in times like these the individual is of small consequence; the private need or preference is swallowed up in the public necessity—to the end that private needs and preferences and individual freedom may *eventually* survive.

We give up individualism to the end that we shall ultimately retain it. We shall not dare to clutch at our private wants or they must be torn from us. We give them up so that we may gratify them tomorrow.

We grasp the hand of the man whose business goes to ballyhack—we are sorry. But this is war. It is inevitable that the activities of peace shall be disarranged. Let us all help by silence and reproach to "can" the bellyache.

Let's organize, as we must, to criticize constructively; do the best we can, but mostly let's drive the dam machine of war until our enemies have had enough. Let's "can" the bellyache; stop the footless chatter of the street, the cheap mouthings of the malcontents. *We* are not overrun by the Hun. *Our* country is not devastated. Its people are not outraged nor its homes made desolate. The only sobs our country has an ear for are the sobs of those whose *hearts* are torn, those who have seen the war come to *their* homes, to demand the supreme sacrifice.

*An editorial written by Harvey Whipple and printed in "Concrete," Detroit, Mich., May, 1918.

Providing Ample Clearance Space

BY M. A. SALLER

A very important factor in the satisfactory operation of power-plant equipment, and one frequently overlooked by the designing engineer, is the matter of providing sufficient space around the equipment to permit the replacement of worn parts. Every operating engineer at some time has been confronted with the necessity of knocking a hole in the wall in order to remove the tubes

PROVIDING SPACE TO MAKE REPAIRS

from a boiler, or has had to move some auxiliary apparatus or piping in order to obtain sufficient clearance to remove and replace tubes in a condenser. Another common mistake is to so locate motors or engines that when occasion arises, for changing the pulley even, it is necessary to remove the machine from the foundation to secure the necessary clearance space.

An easy way to minimize trouble from this source would be for the manufacturer to place on all standard drawings a notation as to the clearance space that should be provided about a machine or outline the space graphically on the drawing. Being thus noted, the point would receive attention by the designing engineer who would probably avoid the common error. This is done by a few manufacturers whose example could be followed to advantage by all.

Editorials

For the Duration of the War

ONE of the most striking things in a war replete with amazing happenings has been the remarkable adaptability displayed by the peoples of all nations. Under the pressure of great necessity and the urge of patriotic impulse they have voluntarily subjected themselves to conditions that before the war were undreamed.

In our own country, where the individual has been accorded freedom of action and opportunity such as no other nation can boast, we have imposed rules, regulations and restrictions that often savor of autocracy rather than democracy. But though in so doing we have shattered scores of precedents, our people have responded instantly and whole-heartedly to every change, convinced that no demand is too unreasonable to be met if it promotes the one great task of the present moment—the winning of the war.

In the name of efficiency and conservation we have turned over the railroads to the management of the Government, arbitrarily restricted the use of certain coals to certain prescribed localities, fixed the prices of fuel and food products, conferred upon the President the power to commandeer any public or private resource for the use of the nation in the conflict, set a guard armed with blue-pencils at the doors of the public press and in a hundred other ways limited and proscribed the operations of public and private enterprises.

Only the absolute need for coördinated effort and the wisest use of our resources could have brought about so radical a change in our methods of conducting affairs, and there are many who believe that when the pressure of necessity is removed, there will be a general reversion to pre-war conditions and modes of doing business.

Piffle and poppycock! Likewise fudge and fiddlesticks! The human race is not a crab. It does not progress backward. The war has thrown the spotlight, as nothing else could have done so effectively, on our criminal wastefulness and our unnecessary duplication of effort. We have realized that we have been working largely at cross-purposes, spending energy lavishly and to no good purpose. No reasonable person will deliberately return to a practice that he has found to be inefficient or contrary to the public welfare.

If the war has forced us to adopt plans that have resulted in better service at decreased cost, with smaller drains upon material and labor, there is going to be no retracing of steps when the war is over. Whatever has been found to be productive of the greatest good for the greatest number will be retained as a part of our system. Any individual or group of individuals who for selfish purposes would attempt to restore obsolete and slipshod methods must be regarded as an enemy of the public. If this war is accomplishing anything at all, it is teaching the gospel of teamwork and wiping out the heresy of self-interest.

Once they have proved their value and have been properly appreciated, economic policies will become a part of the habits of thought and action of the people. "For the duration of the war" is a refrain sung by selfish interests to revive their hopes and reinforce their courage. It is like the quavering whistle of the small boy who passes a cemetery at dead of night.

Celebrate Flag Day

IN 1775, two years before the Stars and Stripes came into use as our National Flag, George Washington wrote, "Please fix on some flag by which our vessels may know each other." Two years later, June 14, 1777, Congress met in Old Independence Hall in Philadelphia and adopted the following resolution:

> Resolved, that the flag of the thirteen United States be thirteen stripes, alternate red and white; that the union be thirteen stars, white in a blue field, representing a new constellation. The stars to be arranged in a circle.

Since that time the number of stars has been increased as the number of states has increased, until today there are 48. June 14 has come to be known as the Flag's Birthday, and it is this date that we celebrate as Flag Day.

We have thrown this country open to millions of emigrants from practically every nation of the world, to come and live within our borders, saying this is a land of freedom and equal opportunity, without teaching the meaning of these terms. For years we have gone along in our peace-loving, idealistic way without giving very serious consideration to what the Stars and Stripes really mean to us, what a precious thing this liberty is, which we have held up as symbolical of our national attitude. Too long have we been doing this, therefore is it no wonder that many whom we have invited to our shores have been inclined to take the duties of citizenship here lightly and in many cases have entirely neglected to assume these responsibilities.

Flag Day offers to every employer in this country the opportunity to bring home to his foreign-born employees what it means to be an American; how that the Stars and Stripes have greater significance to them than ever before, since for the first time in our history men of all nations who have adopted America as their country are fighting under the American Flag on the great battlefronts of France to make the world a safe place for freedom, right and equal opportunity, to enjoy which they came to our shores. There are thousands of foreign-born workers in our industries that have those near and dear to them in our military and naval forces, who would welcome the opportunity to join with the American-born to pledge their loyalty to the Flag and to the great cause we are fighting for, and it is the patriotic duty of every employer in this

country to see to it that his employees have the opportunity on June 14 to get together for a flag raising.

This is a timely occasion for the employer to get the idea across to his employees that they are working for their country and for the boys at the front. This idea, when once instilled, will make strikes, sabotage and restricted output a thing of the past and develop a loyal spirit among native- and foreign-born employees by making them realize that America is the land of the square deal and equal opportunity.

The employer, in addition to producing the materials essential to winning the war, must also help develop a new American spirit. This was very eloquently expressed recently by Secretary of the Interior Franklin K. Lane, in an address before an educational conference in Washington, D. C.

> And we who are not permitted to fight, what shall be our part? Let it be our resolution that when our sons return they shall find a new spirit in America, a deeper insight into the problems of a striving people, a stronger, firmer, more positive and purposeful sense of nationality. We shall make America better worth while to Americans and of higher service to the world.

Flag Day offers an opportunity to help make this resolution a reality.

Cent-a-Gallon Gasoline a Dream

WHILE we are waiting for the report of the five internationally known scientists, who we understand have been appointed by Garabed T. K. Giragossian and approved by the Secretary of the Interior, to investigate the former's sources of free energy and learn whether the said Giragossian is to be a great benefactor to humanity or whether his claims are just plain buncombe, the story of the doings of Louis Enricht, of Farmingdale, L. I., and his "Cent-a-Gallon Gasoline," published in the New York *Tribune*, May 5, an abstract of which appears on page 854 of this issue, will help in provide fuel for our speculative imaginations.

Gasoline at one cent per gallon, if such a thing were possible, would seem to be about the equivalent to tapping the inexhaustible reservoir of energy in the atmosphere. However, as far as we know, the T. K. Giragossian free-energy motor, or "Garabed," as he calls it, exists only in the would-be inventor's imagination, while Louis Enricht has managed to put his mysterious something across in such a way as to interest Henry Ford, B. F. Yoakum and, according to his own statements, the governments of two or three countries, without revealing his method of doing it.

No doubt many of our readers have speculated upon what would be the results if all this was a reality and not a dream or a hoax; how some day all the millions invested in pipe lines, oil-refining and oil-pumping equipment would cease to earn dividends; how gasoline, which is becoming one of the most expensive and essential fuels, would some day be one of the cheapest and most commonplace; how the fortunes of the millionaires of the oil industry would fade away—but you need not speculate any longer, for, according to Louis Enricht's own words, he has had to abandon the idea of his "Cent-a-Gallon Gasoline," and, on account of the great increase in the cost of chemicals during the last two years, his mysterious motor fuel will now cost the public "twelve cents per gallon." When it comes to war profiteering, Louis Enricht appears to be a joy rider.

However, this would-be "green-fluid wizard" seems to be a sort of a generous creature after all, for according to his own statements he has had a conference with Secretary Baker and Attorney General Gregory, and this Government wants his secret for war use only, while he wants the Government to protect him after the war and license him to manufacture his compound and make it illegal for anyone else to produce it. On this plan he will sell his fuel to the Government at ten cents a gallon, and the extra two cents charged the public he is willing to pay the Government as a tax. This, according to his estimate, would enrich the Government by seventy million dollars per year, which is equivalent to a two-cent tax on three and a half billion gallons. Louis must expect to do some business when he gets started, since the total gasoline production in the United States in 1917 was only about two and a half billion gallons.

Like Giragossian, Enricht has always held up the difficulty of protecting his idea as a reason for not revealing his secret, if he has one; and by this subterfuge he has managed to cover himself at every turn from his first public demonstrations in 1916 to what he claims to be his latest offer for his fuel from the Government.

Now that "Cent-a-Gallon Gasoline" has increased to twelve cents in the last two years, it should be enough to convince the trusting public that whatever Enricht may have is a hoax, and that it is only one more of the something-for-nothing schemes breathing its last and about to pass into oblivion. Is it not about time that at least those who are supposed to be familiar with the laws of physics, chemistry and engineering cease to lend their attention to schemes that are so far removed from all laws of reason?

Soot-Blower Data Solicited

ON OTHER pages of this issue is an article dealing with mechanical soot blowers, giving experience from a number of plants as to the saving effected in coal and labor and the character of the service rendered. As far as they go the various reports are favorable, but for the most part they lack definite data to back up the assertions made. Those published are only a few of the responses received. The others merely state that no data on the subject are available.

A loss that may account for two to eight per cent. of the fuel is surely worth analyzing. It would be interesting to know the amount of steam required to blow different sizes and types of boilers, the relative efficiencies of mechanical and hand cleaning and the cost of maintenance in various plants. With these points in view it should not be difficult to obtain data sufficiently accurate for the purpose in hand. We would welcome other contributions to the subject. A general knowledge that a thing is good is not sufficient. Those interested in a device of this character should know how good and at what expense.

There are few engineers and technical men who do not view the move to abolish the study of German language in the schools as a piece of downright foolishness.

Correspondence

Texas Also Needs a License Law

The account in the issue of Apr. 2, pages 463-4, of a boiler explosion in a laundry at Providence, R. I., resulting in the death of three men, and the editorial comment, "Does Rhode Island Need a License Law?" recall an incident that I observed a few years ago in this state.

I stopped overnight in a small town in central Texas and next morning before train time, I decided to walk around and see some of the plants. The first one I came to was a small laundry. The boiler room opened on the sidewalk, so I stepped in to have a chat with the engineer, but there was no one in sight. The boiler was of the horizontal-tubular type, about 35 hp., and judging from its general appearance, it was of a "very indefinite age." The steam gage registered 85 lb., and glancing at the water column, I saw that there was no water in the glass. I had a feeling that as an engineer it was my duty to "stick around." While I was looking the outfit over a boy came into the boiler room from the laundry, and I asked for the engineer.

He said, "Why, the boss generally looks after the engine, but he's gone up town and told me to 'sorter' look out for her until he got back." "Well," I said, "someone had better be 'looking out for her' pretty soon, as your boiler don't seem to have any too much water in it." He blew the column and only dry steam came out. He became very much excited and asked what I thought he had better do. I looked in the furnace and saw that he had very little fire (lignite was being used as fuel) but plenty of ashes. So I told him I thought the best thing to do would be to cover his fire with a few shovels of wet ashes, let the steam drop back, shut everything down and wait for the boss.

I left him shoveling ashes on the fire and have often wondered what the boss had to say when he finished his "political argument" up at the post office and returned to "generally look after" the boiler. This is only one of many instances where the boss "generally looks after the boiler" in small isolated plants, and it shows that Texas as well as Rhode Island needs an engineer's license law.

S. F. FARLEY.

Galveston, Tex.

Greater Efficiency in Internal Combustion

Your editorial in the issue of April 16 on "Internal-Combustion Economy" is timely and I trust will bring out some comparative efficiencies between engines of this type working under the average and best conditions. While a hot cylinder wall is conducive to a minimum jacket loss, the greatest field for improving thermal efficiency is found in expanding the working charge to a greater degree.

The power stroke is now of shorter duration than the compression stroke, but if the working stroke were prolonged until the terminal pressure approached the initial pressure of compression, a larger amount of heat would be converted into work before release. The indicated work with such expansion is from 23 to 26 per cent. greater for the same amount of fuel, but like a single-cylinder steam engine, there is a limit to the terminal pressure, as nothing is gained by expanding steam lower than 18 to 19 lb. absolute because the mean effective pressure of further expansion is less than that required to overcome the mechanical friction of the moving parts; so in an internal-combustion engine, ordinarily twice as heavy per unit of output, it has been found that there is a net increase in fuel consumption with expansion before release to about 23 lb. absolute. The pressure of release at full load is usually 25 to 30 lb. absolute, or above the pressure of initial compression, and the temperature is about 1500 deg. F., while an expansion reducing this pressure to 23 lb. absolute will reduce the temperature of release about 1000 deg. and will increase the total efficiency 12 to 16 per cent.

Of course, an engine with a long stroke has more friction than one with less piston displacement, but a compound noncondensing steam engine has in many cases double the friction of a simple engine of the same output, yet the saving in cylinder condensation exceeds the frictional losses, and noncondensing compound steam engines are commercially successful.

If there were no cylinder condensation of the working medium in a steam engine, the same number of expansions in a single cylinder would show a greater efficiency than when carried out in two or more cylinders. It is the writer's opinion that in its ultimate development the internal-combustion engine will have a working stroke of longer duration than the compression or induction stroke.

C. E. SARGENT.

Indianapolis, Ind.

Excessive Compression Lifted Valve

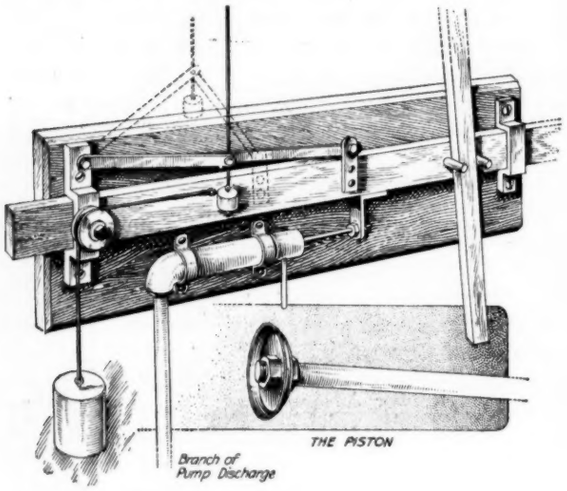
We had a distressing experience for a couple of days after putting a new piston rod in a 20 by 32-in. mill engine. Whenever the throttle was closed, there would be a terrible clattering racket set up inside of the valve chest, continuing as long as the engine was in motion. If, however, some steam was allowed to enter while the engine was slowing down, the noise was not nearly so bad.

The cause was found to be that the new rod was slightly longer than the old one, so that the piston traveled up close to the head end, causing enough compression to lift the balanced slide valve off its seat, but as soon as the valve lifted, the pressure was released and the springs slammed the valve back against the seat.

New York City. J. LEWIS.

Automatic Control for Belt-Driven Pump

A plant of which I once had charge used large quantities of water pumped from a well into an overhead tank to be heated. The duplex belt-driven power pump with hand control proved unsatisfactory as the tank was often either empty or overflowing and wasting hot water, and to overcome this difficulty I made the control automatic by the following means: I extended the belt shifter along the wall back of the pump with two supports for it to slide in. The pump discharge line had a balanced valve, operated by a float in the



BELT SHIFTED BY HYDRAULIC PRESSURE

tank, so that when the tank was full this valve closed and of course the pressure would build up in the pipe line. I connected a branch to this line and led it back of the pump to where the shifter was and connected to it a cylinder made of 1½-in. brass pipe. The piston rod was made of ½-in. iron rod with a cup leather washer on the end to fit into the cylinder; the other end was connected to the belt shifter, which was counterweighted, as shown in the illustration.

When the tank filled and the valve closed, the extra pressure would force the piston and rod outward and shift the belt to the loose pulley, stopping the pump. When the float valve opened and the pressure was released, the belt was thrown on the tight pulley by the counterweight. This arrangement was an improvement over hand control, but it was too sensitive, for the pump would start too often, sometimes making less than one revolution before stopping again. To overcome this, I arranged a jointed brace, as shown, so that when the shifter moved to the off position, the jointed part would drop a little past a straight line, "toggle locking" the shipper until the toggle was tripped again. This was done by a second float in the tank, connected to the toggle and a small weight by a wire. When the water level dropped eight or ten inches the float would trip the toggle, allowing the pump to start and fill the tank, after which it would stop and be locked in the off position again. The pump starts and stops pretty often, but it receives no attention for months at a time beyond an occasional oiling.

New Bedford, Mass. H. K. WILSON.

Removing Piston-Rod Packing

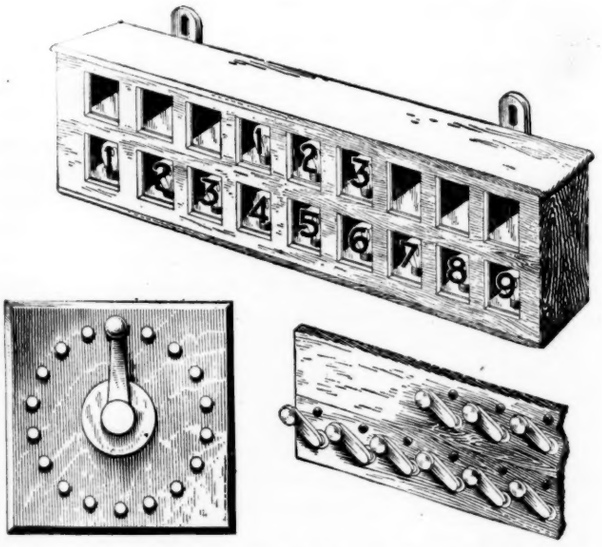
I have a way of my own of removing packing from piston rods of engines, which may be new to some engineers. Place the engine on the center toward the cylinder, remove the nuts which hold the gland in the stuffing-box, open the cylinder cock at the head end and close the one at the crank end, then give the engine a quick turn of about half a revolution and the air compressed in the cylinder will blow the packing out.

This of course applies only to engines that are smal' enough to be turned over by hand, but it is preferable to blowing the packing out with steam, as it leaves the cylinder cool to repack and there is no danger of breaking the gland as when using steam. Care must be taken, however, not to let the engine turn a complete revolution or the gland may be jammed or broken.

Binghamton, N. Y. EDWARD J. DOWD.

Fireroom Load Telegraph

It is convenient for the firemen to know what load is being carried in the engine room, but sometimes rather inconvenient to keep them informed. Various devices are employed for this purpose. The one shown was used in a power plant where I once worked. A box with numbers from 1 to 3 and 1 to 9 painted on its glass front, with a small lamp back of each number, was placed in plain view of the firemen in the boiler room, and a bank of twelve single-pole switches, each one corresponding to a number on the board in the



ENGINE-ROOM SWITCHES AND BOILER-ROOM LIGHTS

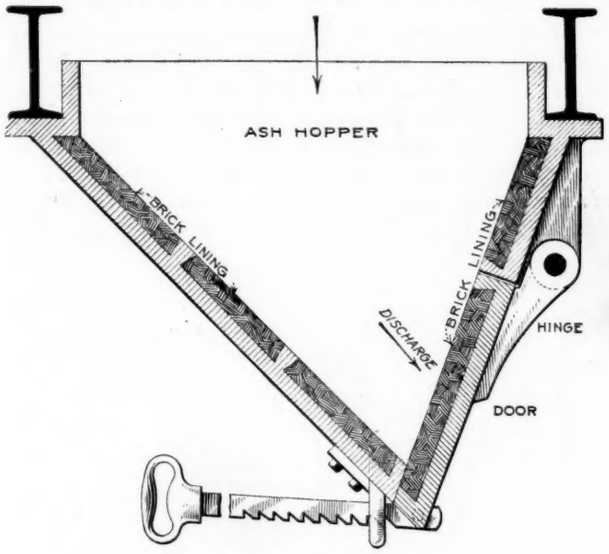
boiler room, was placed handy to the engine-room operator, the upper row to show the load in thousands and the lower row, in hundreds. As the switches were turned on, the corresponding lamps lit up, informing the firemen of the load carried.

A handy bank of switches may be made out of an old rheostat with a lamp connected to each contact button and to a common return wire at the lamp bank. There are enough contact points so that the numbers can progress all the way by hundreds. D. R. HIBBS.

New York City.

Brick-Lined Ash Hopper

In some automatic stokers the ashes from the fire fall into a receiver or hopper below. These ashes may be left in the hopper two or three hours before being removed and carted away. The hopper is made of cast-iron plates which, if not insulated, come in direct contact with the hot ashes and become warped and are soon put out of commission. The illustration shows an ash hopper fitted with a firebrick lining built according to the writer's own ideas and used in a local plant.



BRICK-LINED ASH HOPPER

M. E. DUGGAN.

Kenosha, Wis.

Induced-Draft Fan Puzzle

I once had an interesting experience in connection with an induced-draft fan placed on the roof of a large hotel and used in connection with two marine-type boilers. The construction of the building prevented placing the fan near the base of the stack, and the only available space was on the roof within 20 ft. of the top of the stack; the flue had a great many crooks and turns and was divided into two parts, one from the boilers and the other evidently a ventilating flue.

When tested, it was found that there was no apparent increase in draft over the fires, and the fan was taking considerably more power than was originally figured on. The temperature readings at the boilers and at the fan inlet showed a large drop, which would seem to indicate that the fan was handling a lot of cold air from somewhere. This was puzzling, but it was decided that the flue had a great many small leaks.

In order to determine if there were any large openings between the stack and ventilating flue, a newspaper was torn into small pieces and thrown into the ventilating flue while the fan was running. A few seconds after they went in they came flying out from the outlet of the fan, proving in a very striking manner that there was a hole somewhere in the stack and that the fan was drawing air through it and consequently handling nearly all cold air. This, of course, accounted also for the wide difference in temperature and for the fan taking an excessive amount of power. A hole 12 in. in diameter was found about one-third the way up the stack. Before its discovery the owner of the building was positive there was no hole in the stack, so to square himself the check in payment for the installation was sent at once.

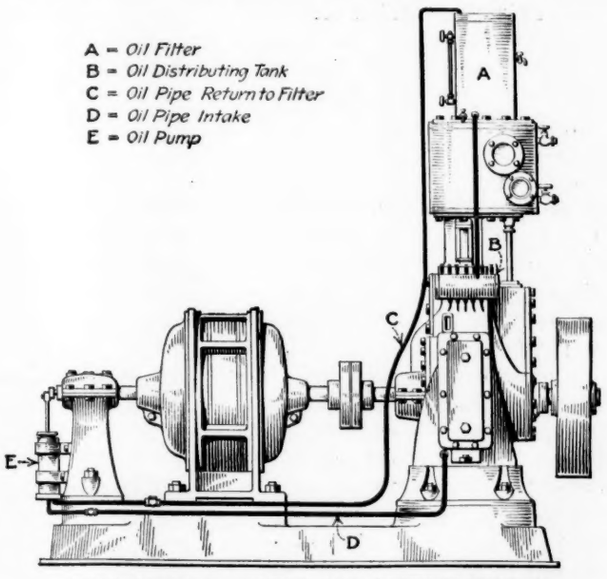
G. C. DERRY.

New York City.

Engine-Oiling System

The illustration shows the general plan of an automatic engine-oiling system of the "home-grown variety" somewhat on the order of the one described by Mr. Morrison on page 60 in the issue of Jan. 8, 1918. Oil from the crank case was originally discharged into a pail, but by the new arrangement the pipe was extended to the end of the bedplate supporting the outboard pedestal bearing, and connected to a home-made pump, from which the oil is discharged to a reservoir and filter located above the engine and drains by gravity to the regular distributing tank on the engine. All of which is "according to Hoyle," but the construction of the pump might be described as something "fearful and wonderful, to wit:

The pump body was a nondescript piece of brass threaded inside at one end for a stuffing-box and outside at the other end for the oil-pipe connections. A 1-in. drill was run through from end to end, forming a working barrel. The piston, piston rod and pump head were originally the stem, disk-holder and bonnet of a bath cock fitted to the size and thread of their respective new mates. Motion is imparted from a ⅜-in. capscrew tapped into the shaft center with a steel pin located ⅜-in. off center, making a ¾-in. stroke crank. The pump body is attached to a cast-iron plate with U-bolts, and that in turn is fastened to the outboard bearing pedestal with studs.



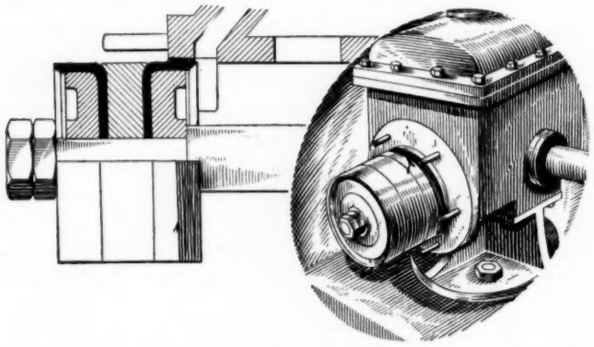
AUTOMATIC OIL FILTER AND RETURN SYSTEM

The description may read like that of the remains of a steam calliope, but the pump does the work just as well as one bought for the purpose and the "automatic oiling system" saves a lot of time and attention.

Ray Brook, N. Y. J. J. BREWER.

Entering Leather Pump Cups

We had considerable difficulty replacing the plunger in a Davidson pump, with a set of new leathers on it. Using sheet iron proved of no avail, but we finally succeeded in the following manner: The edges of the cups were very tightly wound with strong thread and smeared with grease. The plunger then entered easily. Of course after a few strokes the thread was worn off, leaving the cup "lips" to serve their proper function.



STRONG THREAD WRAPPED ON LIP OF LEATHER CUP

Another good stunt pulled off lately was as follows: We have only one brine pump, and when one of the round notched packing gland nuts on a steam piston rod broke one day, it meant shutting down the entire refrigerating system unless it was repaired promptly. The engineer on watch found that a 2½ x 1¼-in. reducing sleeve would take the place of the packing nut, so he put it on and had the plant running again in an hour.

R. J. DALTON.

Woodhaven, L. I.

Water-Heating System

In a silk mill where there was a heavy demand for hot water for boiling the silk, they used to draw cold water into the tubs and bring it to a boiling temperature with live steam through a "full-open" 1¼-in. pipe. To boil 250 gal. it took 15 to 20 minutes. With ten tubs in operation there was a noticeable extra demand on the boilers and the coal pile. After considerable argument I was allowed to put in the following equipment.

The boiler room had a monitor extending along the middle of the roof, below which ran the exhaust pipe of the main engine. In this I built a 1200-gal. tank and put in a closed feed-water heater with 6-in. steam connections and connected the water side to a centrifugal pump with 1½-in. connections from the bottom of the tank to the pump, then to the bottom of the heater. From the top of the heater another pipe discharged into the tank to circulate the water from the tank through the heater and back to the tank. With the centrifugal circulating pump in operation the water was soon heated and kept at from 150 to 212 deg. F.

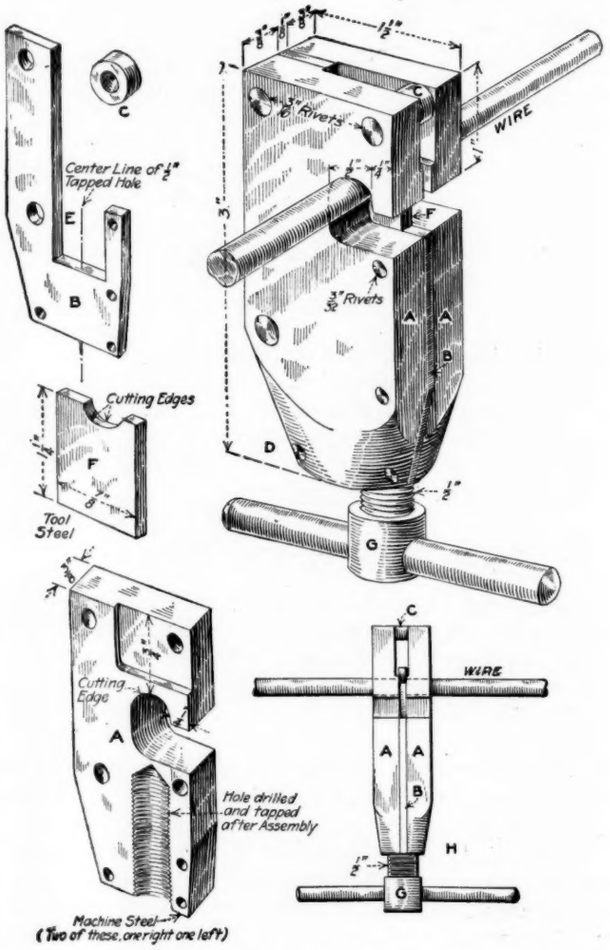
In this room there were two driers, one having 5600 ft. and the other 2800 ft. of 1¼-in. pipe operating under boiler pressure (70 lb.). These were trapped and the discharge led into the hot-water tank, thus saving both heat and water. Water was supplied to the tank by means of a balanced float valve. After this system was placed in operation, it was a common thing to see a tub of water boiled in two minutes, and the saving in coal amounted to about a ton a day, which is pretty good interest on a $600 investment.

H. K. WILSON.

New Bedford, Mass

Screw-Type Wire Cutter

A handy tool for cutting heavy copper wire up to 0.5 in. diameter is shown in the figure. The body of the device is made in four parts and assembled. Two pieces, one right and the other left, are made similar to that shown at *A*, and two other pieces *B* and *C*. The parts are assembled and riveted together as indicated at *D*, after which a ½-in. tap hole is drilled and tapped so that it will pass through the center of the recess *E*



PARTS AND ASSEMBLY OF CUTTING TOOL

in part *B*. The holes should extend well down through parts *A*, as indicated in the figure. The recess *E* in part *B* forms a pocket for the cutter *F* when the tool is assembled. In operation the screw *G* is turned back and cutter *F* dropped into the pocket, thus allowing the wire to be placed in the tool, as shown at *D*. The screw is now turned and the cutter shears the wire between the cutting sides of the shoulders *A*, as indicated at *H*. The parts are made of tool steel and hardened on the cutting edges. This little implement can easily be carried around in the tool kit.

M. P. BERTRANDE.

Ozone Park, N. Y.

Inquiries of General Interest

Relative Loss of Draft in Square and in Round Flues—What is the relative loss in force of draft in square and in circular smoke flues? S. R.

The draft-retarding effect of a square flue is about 12 per cent. greater than of a circular one of the same cross-sectional area.

Charles' Law of Gases—What is Charles' law of the expansion of gases? C. R. D.

The law of Charles, sometimes attributed to Gay Lussac, asserts that all gases have the same coefficient of expansion, and this coefficient is the same whatever the pressure supported by the gas. Hence, for each degree of rise or fall of temperature at constant pressure, its volume will be increased or diminished by a fixed fraction of its original volume. This fraction has been computed to be $\frac{1}{493} = 0.0020284$ on the Fahrenheit scale, the temperature of the original volume being that of melting ice.

Heat Lost in Chimney Gases—What percentage of heat in coal is lost in boiler chimney gases? W. N. R.

The loss depends on the quality, quantity and temperature of the gases. In ordinary boiler practice with natural draft it is customary to supply about 100 per cent. excess of air in order to insure complete combustion. With complete combustion of coal and such excess of air, the losses with different temperatures of chimney gases are about 17.5 per cent. for 400 deg. F.; 21 per cent. for 500 deg. F.; 25 per cent. for 600 deg. F.; 29 per cent. for 700 deg. F.; and 33 per cent. for 800 deg. F.

Chattering of Pressure-Reducing Valve—What can be done to stop chattering and hammering of a pressure regulator used on the steam supply to a steam pump near the steam chest? F. L.

Locate the regulator far enough from the pump so that the volume of steam contained in the pipe between the regulator and the steam chest provides a cushion for the action of the valve without sudden changes of the discharge pressure. This usually will be attained by placing the valve at a sufficient distance from the steam pump to obtain a volume of supply pipe equal to the volume of the steam cylinder of the pump.

Laying Up Heating Boiler—Should a return-tubular boiler that is used for heating be laid up filled or emptied of water? R. L. D.

The boiler should be emptied and after being thoroughly cleaned and dried should be closed up tight. Leaving a boiler stand entirely filled with water during the summer months will prevent rapid rusting at the ordinary water line, but will cause the exterior of the shell and the interior of the fire tubes to rust more rapidly from condensation of moisture out of the atmosphere. Whether the boiler is left filled or dry, the smoke uptake should be disconnected and sealed and furnace, ashpit and all cleaning doors closed tight, to prevent external rusting from circulation of air over the heating surfaces.

Clinker Trouble—Our present coal contains considerable slack and clinkers badly. What is suggested to prevent the trouble? W. B. G.

Keep the fuel bed only about 5 in. thick and fire small charges at frequent intervals. Promptly cover the brighest spots with fresh fuel to prevent holes from burning out that will allow coal to drop through to the ashpit. Avoid excessive stirring of the fire. Any working of the fire bed that may be necessary should be done from the bottom. Keep the bed level by stoking. Leveling the fuel bed with a rake or other firing tool is likely to cause clinker by lifting the ash to the fuel bed. Keep ashpit doors open and regulate the draft with the uptake or stack damper. Promptly quench any ashes or coal falling through the grates. If ashpit is water-tight, keep water standing in it. If that is impractical, blow steam under the grate. The exhaust of a pump or any other supply of waste steam will be beneficial.

Testing Steam Consumption of Engine—How is the steam consumption of an engine determined? W. G. R.

The steam consumption while driving a stated load can be determined by a steam meter that has been calibrated for the conditions, but more generally such tests are made by actually weighing the feed water used for generating the steam supplied or by condensing the exhaust and weighing the condensate. For condensing the exhaust, an ordinary surface condenser may be used, or a series of closed feed-water heaters may be connected together for obtaining sufficint condensing surface. Measurement of the condensate is usually to be preferred to feed-water measurement as less likely to introduce errors from irregularity of working conditions, leakage or use of steam for other purposes than for supplying the engine under test. For establishing uniformity of conditions and reducing the percentage of errors, a feed-water test should have a duration of at least five hours, but with the condenser method an hour's test is sufficient after the normal working conditions have been established.

Quality of Steam Shown by Calorimeter Test—What is the quality of steam determined by a throttling calorimeter test from the following data: Pressure of steam in the pipe from which the sample is taken, 120 lb. gage; temperature in calorimeter, as indicated by the thermometer in the well, 241 deg. F.; pressure in calorimeter as indicated by the manometer, 3½ in. of mercury; barometer 28 in.?

R. G. C.

With a barometer reading of 28 in. the pressure of the atmosphere was $28 \times 0.491 = 13.75$ lb. per sq.in. and the absolute pressure of the steam was $120 + 13.75 = 133.75$, or about 134 lb. per sq.in. absolute; and with a pressure in the calorimeter of 3½ in. of mercury, or $3\frac{1}{2} \times 0.491 = 1.72$ lb. per sq.in. above the pressure of the atmosphere, the absolute pressure in the calorimeter was $1.72 + 13.75 = 15.47$, or about 16 lb. absolute. The heat of one pound of steam in the pipe would be equal to the heat of 1 lb. of the steam in the calorimeter.

In one pound of the steam in the pipe at the pressure of 134 lb. absolute, if

h = The heat of the liquid,
q = The quality or fraction of dryness,
L = The latent heat, then the heat of 1 lb. of the original steam would be $h + qL$, and if
H = The total heat in 1 lb. of saturated steam at the pressure which existed in the calorimeter,
T = Temperature of the superheated steam in the calorimeter as indicated by the thermometer.
0.48 = The specific heat of superheated steam at the pressure in the calorimeter,
t = The temperature of saturated steam at the pressure which existed in the calorimeter,

then the heat in the calorimeter $= H + 0.48\ (T - t)$, and

$$h + qL = H + 0.48\ (T - t), \text{ or}$$

$$q = \frac{H + 0.48(T - t) - h}{L}$$

From observations and the steam table, $H = 1152$ B.t.u.; $T = 241$ deg. F.; $t = 216.3$ deg. F.; $h = 321.1$ B.t.u.; and $L = 870.4$ B.t.u. and by substituting,

$$q = \frac{1152 + 0.48(241 - 216.3) - 321.1}{870.4} = 0.968 = 96.8 \textit{ per cent.}$$

[Correspondents sending in inquiries should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications and for the inquiries to receive attention.—Editor.]

Annual Meeting Boston Section, A.S.M.E.

THE importance of fuel conservation and the remarkable progress in the production of ships in the United States were featured at the annual meeting of the Boston section of the American Society of Mechanical Engineers, held at the Engineers' Club, Boston, Mass., on the evening of May 29. Chairman Albert C. Ashton presided, and the principal speakers were Dr. Ira N. Hollis, past president, and President Charles T. Main, of the national society, and Dr. Charles A. Eaton, of the United States Shipping Board. The meeting marked the climax of one of the best engineering-society seasons ever enjoyed in the New England metropolis. The sessions of the Boston section have been keyed to a high patriotic note; some of the most distinguished officers in the field service of our Allies have addressed it, and the attendance and discussions have reflected a general desire among the members to be of the utmost possible service to the country in this critical period.

Doctor Hollis' Address

Dr. Hollis, who is chairman of the recently appointed Fuel Conservation Committee in Massachusetts, under New England Fuel Administrator James J. Storrow, was the first speaker. He referred briefly to the vital necessity of backing up our military and naval efforts by campaigning at home against every form of waste. America has wasted her natural resources for generations, and the time has come to call a halt. "The subject of conservation," he said, "has come to assume a certain religious aspect, and it is our sacred duty to preserve what the good God has given us, for the welfare of those who come after us no less than for present-day needs. It is the desire of every generation to lift the race a little higher than it found it. Democracy bids fair to fade away if we continue to waste our resources." Dr. Hollis pointed out that coal saving, important as it is, is not the whole end and aim of conservation; the soil, the forests and other resources must be maintained for the general welfare. The speaker said that we must all learn to work together as good neighbors and friends. In closing, he cited an example of teamplay from the battle of Santiago. The firemen on the battleship "Oregon" heard little and saw nothing of the sea fight, and during the long pursuit of the Spanish ships gradually became weary of their arduous tasks at the furnaces. Seeing this, the officer in charge of the fireroom sent a request up the speaking tube that the commander of the vessel authorize the firing of a 13-in. gun to hearten the force below decks. Captain Clark agreed, and presently a 13-in. shell went sailing through the air toward the enemy. Instantly there came a scraping of shovels on the floor and an Irish fireman who had become a bit weary in well doing seized a big shovelful and with a "Take that, you dirty Dago!" hurled home his charge. Such was the effect of a coöperative stimulus upon tired muscles and minds previously out of touch with the stirring events above decks. Every American must take a personal interest in helping the country at this time, the speaker declared, as he took his seat.

President Main on the Fuel Situation

President Main briefly outlined the serious fuel situation which New England is facing with respect to next winter's supply. The New England Fuel Administration estimates that 33,400,000 tons of coal will be needed in the year; the Federal Administration at Washington has reduced this estimate to 30,000,000 tons. There are not enough vessels available to carry the water-borne share of even the smaller amount mentioned. It is estimated that 386,000 tons of shipping would be required to transport the water-borne coal to New England, on the basis of 100 per cent. efficiency in trips and cargo loading and unloading. On Jan. 1, 1918, there were only 200,000 tons available, and a week ago, 276,000 tons. It is anticipated that 60,000 tons more of shipping facilities will be added this year, so that the total estimated tonnage available will be 336,000 tons. The necessity for saving fuel in New England is therefore extreme, and the problem is, How is the manufacturing to be done with the coal which the plants will receive? To answer this question an organized attempt is being made to bring home to the mind of every plant owner in the state the importance of fuel economy, and a booklet has been prepared by the New England Fuel Administration showing how this has been taken up by four representative plants through the organization of shop fuel and efficiency committees, with savings effected during the past winter, and the suggestion that other plants follow suit. Members of the Fuel Administration and engineers in private practice stand ready to assist plant owners in realizing the maximum benefits from their fuel. Extracts from the reports of four plants follow:

Crompton & Knowles Loom Works, Worcester, Mass.

As a result of various steps an economy of not less than 15 per cent. in the use of fuel has been effected. On account of the very unusual winter conditions it is impossible to ascertain the exact amount.

On taking up the matter at the beginning of the winter we appointed from our foremen and executives a so-called Shop Fuel Commission. A little later we appointed a Shop Fuel Administrator, whose business it was to follow up the various methods inaugurated, to see that the best results were accomplished therefrom, and also to see that continued interest was maintained.

The several points covered may be listed under four headings: Improvement in boiler-house practice; improvement in use of power; improvement in use of heat; improvement in use of lights.

Improvement in Boiler-House Practice

1. Raising temperature of feed water by return of condensation. We succeeded in raising the temperature of feed water entering the boilers from 180 deg. F. to 200 deg. F.
2. The burning of all wood scrap and shavings produced in the plant, amounting to five or six tons a day of this material.
3. The establishment of better boiler-room practice by putting observers in the boiler rooms day and night for several days and nights to determine rate and efficiency of firing. The usage of coal by half-hour periods, as fired, was recorded for many days and plotted, from which was evolved a better practice as to uniform and more economical firing.
4. The weighing of all coal supplied to the boiler room and only allowing a certain amount to be used in definite periods. The remainder of the coal was locked up, so that the fireman had to be economical in the use of the portion that was issued to him.
5. Installation of pinhole grates and under-grate blowers to allow use of screenings. While the screenings have not been very high grade, we have been able to conserve appreciably our soft-coal supply. We are analyzing our screenings and discontinuing the use of all that show an unusual percentage of dirt and ash.

Improvement in Use of Power

1. Under the direction of our Shop Fuel Commission, an inspector observed the number of idle machines on which belts had not been thrown off. Vigorous action resulted in the number of machines running idle and wasting power being reduced to an absolute minimum.
2. Where the load was not sufficient to get the maximum efficiency from a motor, conditions were changed to make this possible. All cases of motors working underloaded were eliminated.
3. All overtime that involved the inefficient operation of machinery was stopped.
4. The use of large elevators was restricted to actual needs.
5. Our entire requirements of power had been purchased from the Worcester Electric Light Co. up to last December, obliging us to use live steam for heating. Since the need of fuel conservation became critical we reduced the Worcester Electric Light Co.'s load, at their request, 40 per cent., by operating our own engines and using only exhaust steam for heating. This has been accomplished with practically no increase in the use of fuel.

Improvement in Use of Heat

1. Using only exhaust steam.
2. Under the Shop Fuel Commission a thorough inspec-

tion was made of all doors, windows, transoms, etc., throughout the plant. These were promptly fixed up, and every time the shop shuts down a designated committee goes around immediately after the shutdown and sees that all places are closed. This has saved considerable fuel.

3. On all doors that opened to the outside, automatic door closers were installed.

4. By the appointment of a special inspector we have been able to cut off every day from 20 to 50 per cent. of our heating surface. This has been done by listing the number of feet of heating pipe in the various departments and by having the inspector follow the sun, so to speak, in turning off the steam in the various departments, as the temperature rose in the morning. This saving has been very heavy, as it meant from 200,000 to 500,000 heating foot hours per day. We have upwards of twenty acres of floor space and about twenty miles of pipe for heating.

5. The covering of all exposed steam piping.

Improvement in the Use of Lights

The saving in fuel in connection with the use of lights was large and accomplished in three ways, particularly:

1. The development of interest on the part of the foremen in connection with the problem and actual inspection at various times of the day of lights used, which resulted in the cutting out of a large number of unnecessary lamps.
2. Carbon lamps are replaced with tungsten lights.
3. Reducing the wattage of lamps in places where heavy illumination seemed unnecessary.

DENNISON MANUFACTURING CO., FRAMINGHAM, MASS.

Study was made in the power house to increase the efficiency of the plant, and a considerable gain was made in the number of pounds of steam evaporated per pound of coal. Study of the power and lighting load was made, and a considerable improvement in conditions was brought about by the following changes made in the manufacturing departments:

Heating of the factory was put into the hands of men appointed in each section, who carried out instructions which were given by the Conservation Committee. A schedule of proper temperatures was posted in each room, and the results of their work was checked up from time to time.

Outside of working hours the watchman received specific instructions as to the proper temperature to be maintained, and steam was turned on in the various departments at specified times in the early morning hours.

Thermometers were installed all through the working departments for the purpose of observation, so that the heat in the department could be kept at the proper point without opening the windows or using more steam than was necessary.

Heating coils in bridges and isolated parts of the plant which were not sprinkled were discontinued, and the valve wheels removed so that they could only be turned on by authorized parties, in case of necessity. This applies to the garage and stable, stair tower, toilets, etc.

Steam was shut off the boarding house while rooms were vacant.

Office work was moved in some cases to warmer locations in rooms where it was not necessary to keep the high temperature, and protections were arranged around the desks so that these locations could be heated to a greater extent than the remaining parts of the room.

Any orders for steam in unusual places or outside of working hours had to have the approval of the man at the head of the department.

A study of the use of hot water was made in all departments, and where it was only used for convenience it was shut off. Self-closing faucets were installed in some cases and the number of outlets decreased was over 30 per cent. The use of hot water was discontinued in the main office as well as in the manufacturing departments.

A reduction in the general illumination around the plant was made; the amount of light used under the existing conditions was cut down to the minimum, and in some places discontinued. Lamps of lower candlepower were substituted in many cases for a larger sized lamp. The time when lights were turned on was curtailed. The sign lighting was discontinued and the street lighting and factory-yard lights were reduced to a minimum consistent with the safety of the plant and the prevention of accidents to employees.

The watchmen were instructed to see that unnecessary lights were not left burning where night work was going on or at any time outside of working hours. All electric and gas-heating applications were turned off from 10 to 15 minutes before closing time. Lamps of less candlepower were used for all indicating lamps, and on instruments in the power house.

In order that the peak load, due to lights, should be eliminated, all passenger service on elevators was discontinued when the lighting load came on, and certain heavy machines, such as the coal carrier in the power house, paper calenders, machinery in the carpenter shop, and certain elevators, were shut down at 4 o'clock or thereabouts, and in this manner the peak load due to lighting was largely eliminated.

The total power and lighting load showed practically a flat curve throughout the day.

Many receiving doors and entrance doors were protected by storm porches and by weather-stripping the cracks around the doors to prevent a large amount of cold air from coming into the building. The space between the box frames and the brickwork in all the buildings was closed up to prevent too much air entering in this manner, and weather strips were put on the window sash in many cases where there was bad exposure. In all departments after the lights were turned on the window shades were pulled down to minimize transference of heat through the glass.

A study was made of the use of steam for process work, and exhaust steam was substituted for live steam wherever possible. Instructions were given operators to keep vent pipes closed. More careful inspection was made of all traps, and in many cases automatic return valves were installed to do away with hand control in such cases. The steam was shut off machines some time before closing instead of waiting for the closing gong. In many of the departments the work was laid out so that for certain periods of the day machine work could be done, and at other times the power was shut down.

The use of compressed air was studied, especially with a view to discontinuing its use wherever possible, and the use of the compressed air for cleaning was discontinued.

In obtaining these results it was necessary to interest everyone in the proposition, and means were taken to keep the different groups of employees informed of the savings which had resulted from the changes in operation.

According to the best estimate we could make, taking into consideration our production figures, outside temperatures and quality of coal, we made a comparative saving of 15 per cent. during the year. At our 1916 rate of consumption this would amount to approximately 1350 tons. During the winter months, when we have our greatest coal consumption, we attained by various economies or greatest savings, in some weeks there being as high a reduction as 32 per cent. in our use of fuel.

In reaching these results we reduced the power demand by about 16 per cent., largely through reduction in the lighting load. The reduction in the power load was largely accomplished by rearrangement of working schedules.

ATLAS TACK CO., FAIRHAVEN, MASS.

Our first step was to make all windows and doors as nearly airproof as possible and to instruct our watchmen, especially the man who attends to the heating, to look for all steam and air leaks and to report at once in case any of these should exist, that they might receive immediate attention. The factory's temperature was usually from 55 to 67 deg., according to the character of the work done in each department. We installed in our heating steam pipe a steam-recording gage and allowed only a certain pressure, according to weather conditions. In this way the man attending to the heating shifted the heat from one room to another in order to keep the factory comfortable to work in.

We repaired all steam traps thoroughly, so that all condensation was returned to our boilers, and we also covered all exposed steam pipes with 80 per cent. magnesia.

In our pickling and scaling department we installed a steam-reducing valve lowering the steam pressure from 150 to 60 lb., and also placed in the pickling tubs automatic temperature-control valves, making hand regulation unnecessary.

In the eyelet department automatic control valves and thermostats were applied to all japanning ovens to admit only sufficient steam to keep the necessary oven temperature, all condensation being returned to the boilers by gravity, and eliminating all pumping that would otherwise call for considerable power. We covered the tops of boilers with asbestos cement 2½ in. thick, lowering the outside temperature 10 deg. We have installed on all boilers water columns, high- and low-water alarm, preventing wide fluctuation of water level and assuring much better economy. We have also on each of our boilers a boiler-efficiency meter. This shows the firemen at all times the condition of their fires, and has proved a useful and economical instrument.

We installed a V-notch recording and indicating water meter to measure accurately the water pumped to our boilers and show to the boiler-room force the amount of water evaporated per pound of coal.

On account of the limited tube area in our former feed-water heater, we were unable to get the best results from our exhaust steam. These tubes have been replaced by a more efficient set, resulting in 20 deg. increased temperature. At present our feed-water temperature leaving the heater is 130 deg. and leaving our economizer to boilers, 230 deg. Our boiler feed pumps were repaired and put in first-class condition.

In the engine room all valves are set for the highest economy, and we have installed three switchboard recording watt-hour meters. We are about to install a 5-hp. motor to take the place of our steam engines to run the economizer scrapers.

We are installing hand stoker grate bars, which, according to the builders' rating, will give us about 50 per cent. more boiler rating and about 25 per cent. saving in coal.

We have abandoned our old cooling tower and are installing a spray-pond condensing equipment with motor-driven centrifugal circulating pumps.

All boiler settings and brickwork are examined for necessary repairs and tubes in boilers scraped.

I believe that in 1918 our increased efficiency will net us a saving of at least 20 per cent. in fuel.

THE GEORGE E. KEITH CO., BROCKTON, MASS.

We have a peculiar plant, in that the buildings are widely separated and there is a great deal of heating radiation in all the buildings. The buildings are of wood frame construction and not as tight as they might be. We appointed one man to patrol these buildings three times a day and to record the temperature in each room. This man was made responsible for turning on and shutting off the steam in each department, and in this way we kept the temperatures down to a minimum, so that there was no extra radiation loss.

We have covered every pipe in the entire plant that was carrying high- or low-pressure steam. We have even made it a practice to cover the return pipes. We have experimented to some extent with asbestos covering on the brickwork of the boiler settings. We have covered one boiler to see how the proposition worked out, and undoubtedly will apply this covering to the other boilers. This covering not only cuts down the loss due to heat radiation, but also stops any air leakage, which in the opinion of the combustion engineer is the most serious loss in the entire plant. Air leakage causes a dilution of gases, and we do not get the percentage of CO_2 which gives us maximum efficiency. Consequently, anything which will cut down air leakage around the settings will save coal more than any other method of boiler efficiency.

We were driven to the burning of screenings because we could not obtain soft coal. In fact, we have been burning screenings in some of our boilers for two or three years with good results. We had to install small forced-draft blowers to get results, but have succeeded in burning as high as 70 per cent. maximum of screenings and soft coal.

We have placed traps on every drip or outlet in the entire plant and on the ends of all heating coils. We have arranged our return system of piping so that there is no loss from any of the piping. All the returns come back to our boiler room and are used for boiler feed. This eliminates the expense of makeup water and of course gives us a boiler feed temperature of about 206 degrees.

We have installed a thermometer system whereby the firemen can tell what the temperature is in any building merely by pressing a button. This thermometer is an electric apparatus operated by means of an electrical contact placed in each building.

We have made it a practice to burn all the scraps and waste from the factories.

We have several items for future development, in that plans are being started for a new central heating plant. We now have three isolated heating plants which cause more or less inefficiency, in that the boilers are old and coal cannot be burned to good advantage. We intend to install automatic stokers, weighing devices for recording the amount of coal used, and coal and ash handling apparatus. We intend to lay out our steam mains and steam piping so that all losses will be cut to a minimum.

We have outlined a system of work through our entire plant; are casing up all the windows, making all of the doors tight, and arranging doors so that they will close automatically, thus doing away with any loss from leaving them open. We have placed vestibules inside the factories where we have any shipping doors.

Skilled Enlisted Men To Be Returned to Necessary Industries

In response to appeals from all over the country, the War Department has decided upon a policy that will permit the return to necessary industries of highly skilled men taken from such industries, under a system of furlough which will be automatic and which will not in the future as in the past leave to the discretion of company and other subordinate commanders the question of whether such furloughs shall be granted. Thousands of applications for such furloughs are now being sent out of Washington by various branches of the War Department, in response to the appeals of manufacturers and other producers of war material whose draftsmen, mechanics and other employees, engaged in the past and now upon Government orders for war work, have been taken from them by operation of the draft.

The application blank is as follows:

APPLICATION FOR RETURN OF ENLISTED MAN IN HIGHLY SKILLED CLASS OF LABOR TO NECESSARY INDUSTRY

Dated at.....191

Application is hereby made for the return of following enlisted man:

Name..... Residence.....
Exact description of trade.....
Registered local board.....Order No.....Serial No.....
Last reported to camp.....Unit.....
Taken into Army.....191, because.....
.....
.....
We ask that he be directed to report to.....
.....
We have the following direct Government contracts:

Date	Gov. Order No.	Quantity	Description	Dept. of Gov.
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....

We are under contract with the following, who have direct Government contracts from.....Dept.....
.....
.....
We have established our status as "necessary" industry with District Board No..... of State.....located at.....
.....
By.....(Title)

Sworn to before me at.....
this.....day of.....191

.....
Title of official administering oath.

I have checked the foregoing statements and have found them to be correct.

.....
.....
Local representative of.....Dept.

The adoption of the new policy means that enlisted men are to be returned to industry only in cases where the drafted man's employer is willing to swear that the man is badly needed and that no one can take his place. The Government department for which the manufacturer or other employer is working will, upon application, send one of the blank forms to the employer, which he must fill out, swear to before a notary, and have a Government inspector who is conversant with the facts also sign. The signed application then goes to the Adjutant General's office, with request from the interested Government department that the man wanted be granted an indefinite furlough, without pay, with the promise that after the need for the man's service has passed he will be returned to the Army.

While such men are on furlough they are not to be allowed to wear the uniform. The company employing them must furnish the Government each month a report that they are still in employment and the class of work engaged in. In case such men leave their employment, the employers must immediately notify the Government.

Thousands of applications for furloughs for enlisted men in necessary industries have recently reached Washington, and Washington has been unable to grant permission for the necessary furloughs because company commanders and other subordinate officers could not be convinced that certain of their men might be more necessary in civil life than in the ranks. The Adjutant General's office has sent a circular to heads of War Department divisions permitting the new system. The Government is protected, from the army-in-the-ranks point of view, by the fact that wherever a fraud is perpetrated or attempted a sufficient number of persons will be familiar with the circumstances to result in the War Department being notified.

Skagit River Development

The Seattle City Council has definitely decided to proceed with the development of the Skagit River power site, which has been offered to the city free of cost, and all bids for the sale of other sites and the construction of plants for the city have been rejected. As soon as the necessary plans can be completed, bids for the work will be called for by the Board of Public Works, C. B. Bagley, secretary.

Covering in every detail the construction of the proposed hydro-electric power project on Skagit River, Superintendent of Lighting J. D. Ross has submitted to the Board of Public Works a report which shows the initial cost of the first development to be $4,712,080. These figures include the 103-mile transmission line necessary, with an estimated cost of $1,214,000. The summary of the report follows:

The total available power on this river, without storage at the lower or Gorge Creek plant, is 900 cu.sec.ft., capable of developing 25,000 hp. continuous 350-ft. head. The total available on the stream for three plants without storage is 900 cu.sec.ft., capable of developing 65,000 hp. continuously.

After impounding the water by Ruby dam, the equalized flow of the river is estimated to be 4000 cu.sec.ft., capable of developing 289,000 hp. About 350 square miles out of the drainage area of 1100 or 1250 square miles is on the Canadian side.

As far as known none of this can be economically diverted, but no data have as yet been obtained on the Canadian side. For this reason and to be sure of possible low-water years we base our estimates on 200,000 continuous horsepower instead of 289,000. The drainage area is the largest of any Washington power site, being estimated at the lowest to be 1090 square miles and the highest estimate gives 1250 square miles.

The total available fall of the river is 950 ft. and the site lends itself admirably to a successive development in three steps.

The transmission line is 103 miles to the north city limits. The voltage would be 110,000, and the loss in transmission with both lines operating will be 5 per cent. at full load of 50,000 hp. Our estimate includes two lines on steel towers the entire distance. The entire works of the three plants, including foundations, tunnels, the three concrete dams and all reservoir capacity, is set in rock. The tunnels are flow-line tunnels only, being under less than 100 per cent. pressure at any place.

The lowest tentative bid received on this project is $2,381,000 for 50,000 hp. installed, being a price of $47.62 per horsepower. The Cedar original plant, one of the most economical in America, cost $57.74 per horsepower. Estimating $1,240,000 for two transmission lines on steel towers and $275,000 for substations, the cost per horsepower on this bid would be $81.52 per horsepower in Seattle. The Cedar River plant, including substation, cost $95.55 per horsepower.

This estimate includes a diverting dam 25 ft. high and a flume and tunnel 12,000 ft. long.

The dam can be raised to elevation 850 ft., making it about 100 feet high. The rock is exposed on both sides at the best location. The plant then becomes entirely permanent. This permanent plant will cost about $3,499,000 for 50,000 hp. This is $69.98 a hp., installed. With transmission lines and substation all permanent steel and concrete construction, the cost will be $4,998,080, or $105.01 per horsepower ready for distribution at Seattle.

The report of City Engineer A. H. Dimock on the same project states:

The average cost a delivered horsepower of the various projects considered by the city, as follows: Stillaguamish River, $124; Wallace River, $132; Packard Lake, $224, and Skagit River, $105.

Considering the merits of the Skagit River power proposition, however, due allowance must be made for the value of the undeveloped power. On the most conservative basis there is available in this river a total of 289,000 hp., or 230,000 hp., in addition to the 50,000 hp. to be considered in this statement. It is entirely probable that further study of the capacities of this river may show a still larger amount.

The above is based on the lowest flow record obtainable. The value of a horsepower installed of undeveloped power is, of course, difficult to determine. In a discussion on the development and operation of hydroelectric plants in the proceedings of the American Institute of Electrical Engineers for the year 1909, it is stated that the value of land and water rights would average about 10 per cent. of the cost of a horsepower installed, or in this case $10 per horsepower. If this assumption be correct, the value to the City of Seattle of the power possibilities on the Skagit River, which may be obtained without any cost whatever, will be nearly $3,000,000.

All the items entering into these plants will be of the most permanent and durable character. The dams would be of concrete on rock foundations and with rock sidewalls. The water would be conveyed from reservoirs to power house by tunnels through the mountains, also constructed in solid rock. The power houses and equipment would be of the safest possible construction.

It has been shown by the foregoing figures that the present cost of the development of the Skagit River is lower than that of any other, and that it has possibilities for future development and for supplying the power needs of the city for many years to come.

The acquisition of this project and its development as needed will enable the City of Seattle to supply power to its customers at the lowest possible rates. There can be no question that the Skagit River affords the finest opportunity to the City of Seattle, both for present and future needs.

N.E.L.A. Convention at Atlantic City

The National Electric Light Association, as announced in a previous issue, will hold its annual convention at Atlantic City, June 13 and 14, the tentative program of which is as follows:

Thursday Morning, June 13—Presidential address; reports of secretary, treasurer, membership committee; reports Commercial, Technical, Accounting and Electric Vehicle Sections; new business. Thursday afternoon—Report of National Commitee on Gas and Electric Service; report of committee on public utility conditions—war financing of utilities, rate increase activities, etc.; report of public policy committee; discussion of central-station aspects of the labor problem; female employment; meter reading and testing; economized accounting. Thursday evening—Patriotic addresses on the broader national topics of immediate importance to the industry, by distinguished speakers (details in the hands of the president). Friday morning, June 14—Address and general discussion on the coal situation; important war-time topics introduced by the Technical and Hydroelectric Section. Friday afternoon—Important war-time topics introduced by the Commercial, Accounting and Electric Vehicle Sections. Friday evening—Round-table discussions and films of war activities of special interest to member companies, with other appropriate features.

Convention headquarters will be at the Hotel Traymore. Hotel reservations are in the hands of Frank W. Smith of the convention committee, 130 E. 15th St., New York.

Pleasure Yachts May Be Deprived of Fuel

It is probable that the United States Fuel Administration will issue soon an order prohibiting the use of coal and fuel oil by private yachts—meaning any vessel operated not for profit.

Incomplete figures now in hand show an average in commission for the last three years of 282 private yachts driven by steam and more than 1000 driven by gasoline. The total fuel used in these vessels has been deemed worthy of consideration at a time when a shortage of fuel is inevitable. The elimination of these craft would also release a considerable number of men for work in the war industries.

It has been shown that hundreds of vessels formerly operated as private yachts have been turned over to the Government for use in the war.

Navy Needs at Once One Thousand Gas-Engine Men

The Naval Reserve Force must enroll at once 1000 men experienced in the operation and maintenance of gasoline engines. This is an urgent call. The men are required for immediate duty. They will be rated as machinist's mates.

Age limits are 18 to 35 inclusive. Applicants must be American citizens. Draft registrants with letters from their local boards will be accepted.

Apply at Naval Reserve Enrolling Office, 51 Chambers St., New York City, or any navy recruiting station.

Cent-a-Gallon Gasoline Dream Ended

Robert H. Rohde, in the New York *Tribune*, May 5, 1918, gives a very illuminating and lengthy history of Louis Enricht, of Farmingdale, L. I., and his "One-Cent-a-Gallon Gasoline," under the title, "The Amazing Tale of a Cent-a-Gallon Sorcerer." No doubt many of the readers of *Power* will remember how this Louis Enricht sprung into public attention overnight, back in 1916, when he announced to the world that he had discovered how, by mixing a small amount of a green liquid, compounded by himself, into a quantity of water, the latter was immediately converted into a motor fuel equal to gasoline. According to Mr. Rohde's narrative, the early demonstrations of Mr. Enricht's invention were made on a so-called cycle car, and were of a nature as follows:

A bucket of water would be supplied from an old pump, then the witness would be invited to drink of the contents of the bucket, which invariably proved to be plain water. This same water was used to fill the tank of the cycle car. A small bottle containing a green fluid would be shaken over the mouth of the tank. The mixture in the tank would be stirred and the cap affixed. A twist of the crank would start the engine with a curl of vapor that smelt vaguely sweet shooting from the exhaust. Your attention was invited to the odor of the vapor. Then off you went to experience just the same sort of ride you would have had if you had been covering the same road in a cycle car by gasoline.

Perhaps there would be a little of the fuel left in the tank when you returned. Enricht would drain it at once through a pet cock and watch it disappear into the earth. "I must be careful," he would say, "if a few drops of the fluid gets into other hands, my secret is gone. It is easy to analyze, and I do not know how I shall protect it." When you talked it out with him and considered the problem from the inventor's view, this was one of the great arguments for secrecy, a valid reason why there might be delay to giving the boon of "Cent-a-Gallon Gasoline" to the public.

How could the secret be protected? That was the question. The ingredients, Enricht explained, were simple. They could be bought at any drugstore. A child could mix them in the proper proportions. There was nothing to prevent automobile owners from doing that very thing.

Then along came Henry Ford, who "joyrided" many a mile under the impulse of the Enricht fluid. He hunted and hunted for the joker but couldn't find it. He put Enricht in possession of a brand new flivver, straight from the shops; and Enricht poured water into its in'ards and added a little of the green stuff, stirred the mixture, turned the crank and off he and Henry went. But one day found this a closed incident. Henry had seen "Cent-a-Gallon Gasoline" in operation. He had been for a time convinced of its revolutionary merits. He had openly referred to Louis Enricht as a great man. It was said he had made a magnificent offer for the secret, planning perhaps to publish the full history as a benefaction to motor drivers. Maybe the offer wasn't magnificent enough; maybe Ford suffered a change of heart and mind and withdrew it.

He and Enricht parted. They were not friends. Ford sued Enricht for the return of the flivver which had figured in the demonstrations. Officers of the law under due process removed the flivver from Enricht. The old inventor immediately began action against his erstwhile crony. It seems he had substituted for the Ford engine one of his own, so the replevined flivver wasn't really Ford's property at all. And in that litigation Enricht dropped out of sight once more. Some weeks, or some months, passed, then entered B. F. Yoakum.

Enricht and Yoakum had been neighbors. Yoakum was the rich man of Farmingdale. The National Motor Power Co. was organized with Enricht and Yoakum in control. To the company Enricht assigned his secrets in exchange for stock. Now he says that stock was all he got—and all the company had. He insists that the whole capital of the enterprise lies in the value of the secret he had to sell.

As he had fallen out with Ford, so Enricht fell out with Yoakum. In this case a formal offer appears to have been made by the British Government after a protracted period of tests. It was because of a secret sympathy with Germany, the plaintiff alleges, that Enricht would not deal with Great Britain.

The affidavits filed at Mineola were most interesting. They recited how in months of demonstration in the laboratories of the Automobile Club of America Enricht had run engines he had never seen before, engines that could not possibly have been tampered with, on this fuel. Experts had watched every move he made. Moreover, it was asserted that the fluid was no longer the complete mystery of the early days. Yoakum had kept pressing Enricht, demanding as a business associate, his closest confidence. He insisted that the secret should become the property of the National Motor Power Co. And in a measure Enricht had given way. He had made public, at least within the circle in which sat Yoakum and the British experts, a list of ingredients entering into the compound, withholding only one element.

The ingredients were, as he said, common. The experts had bought them and compounded them, leaving it for the inventor to complete the fuel by shaking into each tankful a few drops of liquid from a little vial that never left his possession. Without this liquid the compound gave only slight evidence of motive power.

That little private bottle never left Enricht's possession, but one day it almost did. According to his own story, he had been lured into a deserted road near Farmingdale one day and had found himself confronted with armed men who demanded the bottle, which Enricht at length produced. However, it seems that Enricht had been prepared for some such contingency as he met on that lonely road, for according to his story he had provided himself with a duplicate bottle and it was the dummy he surrendered to the holdup men.

The foregoing is just another one of the questions that keep cropping up at every turn with Enricht and his fuel. However, at every turn he has kept himself covered.

Within the near future the case of Yoakum vs. Enricht must be coming up. Then it will rest with the courts whether Enricht shall be ordered to give to the National Motor Power Co. his full secret.

In the pendency of the suit, Enricht, by his own statement, has been in conference with Secretary Baker and Attorney General Gregory. He asserts the United States Government has made him an offer in excess of that made by the British Government, contingent, of course, on his fluid being all he claims it to be.

"The Government wants my secret only for war use. What I want the Government to do is to protect me after the war. I propose that I should be especially licensed to manufacture the compound, and that it be illegal for anyone else to make it. On that plan I was ready to sell my fuel to the Government for 10c. a gallon and to sell to the general public at 12c. a gallon, of those sales pay a tax of 2c. a gallon and enriching the Treasury at the rate of something like $70,000,000 a year."

So the "Cent-a-Gallon Gasoline" idea has been abandoned. Enricht explained that the cost of chemicals he needs has greatly advanced within the last two years.

"They have had the wrong idea from the first," he says. "Their theory is that I change the chemical composition of water, and they say truly that I must spend more energy in the process than would be produced. As a matter of fact, water is just a carrier. It takes minute quantities of my high explosive through the carbureter into the cylinder. Simple? Eh?"

Thus ends the dream of "One-Cent-a-Gallon Gasoline."

John Coats Takes a Bath

According to the *Electrical Experimenter*, all institutions depending upon the Marion (Ind.) Electric Light and Power Service were without current for a minute recently, and all because John Coats, who takes his regular Saturday evening bath at his home, got hold of a live wire in attempting to shake into life a defunct electric-light globe, and could not let go. Standing in the water with a 110-volt current coursing through his body, all Coats could do was to yell for help. A neighbor quickly discovered his plight, and telephoned the light company, who turned off all current. Coats was injured only in feelings.

Tar Oils for Use in Internal-Combustion Engines*

By A. Vincent Clark

The different classes of both solid and liquid fuels vary greatly in their calorific value. Some crude oils have a calorific value of about 20,000 B.t.u., whereas the heat value of tar oil is only approximately 16,000 B.t.u.

The various groups of liquid fuels show great differences during the process of combustion, and those rich in hydrogen are much more readily combustible than those deficient in this constituent, which is the case with tar oil, with the result that it cannot have a perfect gasification and combustion. Crude tar and the thick tar of gas-works are really intermediate between liquid fuels and coal, and usually the liquid requires some refining before being suitable for use as fuel for internal-combustion engines.

The accompanying table gives a comparison of the composition of various fuels as regards their percentage of carbon and hydrogen.

COMPARISON OF COMPOSITION OF VARIOUS FUELS

	C Per Cent.	O Per Cent.	H Per Cent.	Free H Per Cent.	Molecular Ratio H/C
Benzine	84.5	0.5	15.0	15.0	2.13
Petroleum-oil gas	85.0	2.0	13.0	13.0	1.84
Benzol (C_6H_6)	92.3	—	7.7	7.7	1.00
Tar oil	87.0	5.5	7.5	6.8	0.94
Heavy tar	86.0	9.0	5.0	3.9	0.54
Coal (flaming)	85.0	9.5	5.5	4.3	0.60
Coal (caking)	88.0	7.0	5.0	4.1	0.56
Lignite	64.0	30.0	6.0	2.2	0.41
Anthracite	94.0	3.0	3.0	2.6	0.33
Wood	50.0	44.0	6.0	0.5	0.12
Cellulose	44.4	49.4	6.2	0.0	0.00

Tar oil suitable for use in Diesel engines should have a specific gravity at 60 deg. F. not to exceed 1.1, calorific value not less than 15,700 B.t.u., fluid at 60 deg. F., and a maximum content of water, coke and ash not exceeding 2, 5 and 0.1 per cent., respectively.

Tar oils have been successfully used on some makes of Diesel engines without alteration being necessary to the engine, but more frequently cleaning is usually required when this oil is used and the pulverizers should be cleaned about every 100 hours. The carbon deposit is generally not very difficult to remove and can easily be cleaned off with a blast of air.

It has been found that engines work better on the tar oil when the load is fairly uniform, and less cleaning is required if they are able to keep running continuously at about full load. It is always necessary to start the engines on refined or light crude oil, and if they have to run with a light load, this oil must be continued until the load is increased. No alterations are needed to the setting of the valves whether the engines run on petroleum or tar oil, but in some cases it has been necessary to alter the flame plate of the injection valve to give a sharp edge around the orifice. It is advisable not to turn on tar oil until the jacket-water temperature has reached at least 120 deg. F., and in cold weather it is advisable to pre-heat the tar oil before it enters the fuel pump.

Attempts have been made to run engines with mixtures of refined or crude petroleum and tar oil, but such mixtures have been found liable to produce trouble, probably because of the oils separating out in the tank or distributing pipes, owing to the difference in their specific gravity, so that the actual fuel passing into the cylinders is not of uniform quality. This has been found to be especially the case in cold weather, but the difficulty is quite overcome by using separate pumps and pipes for delivering the two oils separately right up to the injection valve, and this system has been successfully employed on the Mirrlees Diesel engines.

The Mirrlees engine has been adapted to run on tar oil by the employment of what may be termed an ignition oil, which may be refined or light crude, and a small quantity of this latter oil is admitted before the tar oil in order to start combustion. This ignition oil is only about 5 per cent. of the amount supplied. Combustion begins, and the temperature of the gas inside the cylinder is raised by the burning of the ignition oil, so that as the heavier tar oil is immediately afterward injected into the combustion space it is at once ignited, the temperature being high enough to allow proper combustion. The method which is adopted involves the using of two separate pumps, one supplying ignition oil and the other tar oil, the latter being under the control of the other. The two oils enter the fuel valve by different passages, and the ignition oil is admitted as nearly as possible at the bottom of the needle. By this means the lighter fuel is first injected into the cylinder and the arrangement gives quite satisfactory combustion of the tar oil, so that practically an invisible exhaust is obtained. This method of injecting the fuels also reduces the amount of carbon deposit in the combustion space, and the valves and pistons show remarkable freedom from deposits, so that they do not require much more attention than is ordinarily given to these parts.

The engines of the semi-Diesel type may also be run successfully with tar oil as fuel by using an ignition oil, but these engines need an increased amount of the latter, varying according to the design, up to approximately 30 per cent. Upon running them on tar oil it is found that after they have been working for some time at about full load, the amount of ignition oil can be reduced, provided the load remains constant, and in some cases entirely cut out. Probably this feature can be explained by the formation of carbon in the combustion chamber remaining incandescent, and thus serving to ignite the incoming charges of tar oil.

Generally speaking, the hot bulbs need cleaning every day, as a large amount of deposit accumulates in them, which if not removed will make the engine difficult to start and there is a possibility that the bulbs will eventually become completely choked. In addition these engines are much more susceptible to changes in the quality of tar oil than engines employing high compression.

*Abstract from an article in the April issue of "Gas and Oil Power," London, England.

Applications for Water Appropriations

Applications have been filed with the California State Water Commission for the appropriation of water for the generation of power by the following:

The Nevada-California Power Co., of Riverside, Calif., has applied for 12 sec.ft. of Birch Creek in Inyo County for the generation of electric energy to be developed at existing power plants Nos. 2, 3 and 4, by falls 913, 791 and 995 ft., respectively, the horsepower to be developed being 1244, 1079 and 1356, respectively. After use it is proposed to return the water to the Hillside Water Co. The estimated cost of the works is $42,500.

The Southern Sierras Power Co., of Riverside, Calif., has applied for 12 sec.ft. of Birch Creek when said water may be available, for the generation of electric power at existing plants Nos. 5 and 6 of this company. It is proposed to develop 500 and 513 hp. by falls of 366 and 230 ft., respectively, the water to be returned after use to the Hillside Water Co. The estimated cost of the works is $42,500.

Chicago Edison Company's Off-Peak Rates

Some of the figures given on page 747 of *Power* for May 21 do not correctly represent the off-peak rates of the Commonwealth Edison Company of Chicago. George H. Jones, power engineer of that company, states that for off-peak business a limited-hour contract is offered, modified by a rider which provides for an annual guaranty of $24 per kilowatt of demand required. The contract is on the demand basis, the off-peak demand charge being $1.40 per month per kilowatt for the first 25 kilowatts and 90c. per month per kilowatt for excess. The energy charge is 3c. per kilowatt-hour for the first 5000 kw.-hr. of consumption per month; 1.3c. for the next 25,000 kw.-hr.; 1.1c. for the next 70,000 kw.-hr.; and 0.9c. for over 100,000 kw.-hr. A cash discount of 10 per cent. is allowed on the energy charge.

Men Wanted for Submarine Duty

It is desired to call the attention of young men who have had technical training and experience to the fact that their abilities can best be put at the service of the country by selecting a branch of service in which their special qualifications will be of the greatest use.

The Submarine Force of the United States Navy requires the services, as officers on board submarines, of young men who have had technical training in mechanical and electrical engineering and who have had experience in these professions. It is intended to enroll a number of such men as provisional ensigns in the Naval Reserve Force, give them a course of instruction in deck duties at Annapolis and a course in submarine work at New London. Those who successfully pass these courses will then be sent on board submarines for regular duty.

It is requested that any men who desire this duty and who are qualified as below outlined, send their names and addresses to the Commander Submarine Force, U. S. S. "Chicago," care of Postmaster, New York. Qualifications required: Desire to serve in submarines; degree of M. E., E. E. or E. M.; 2½ years' practical experience in profession; not over 35 years old; physically strong and sound. Candidates should, if practicable, receive the indorsement of one of the following organizations: Naval Consulting Board, National Research Council, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Institute of Mining Engineers.

Government Calls for Thousands of Technical Men

You may hit the Hun without going to France. In other words, the great army of specialists behind the men behind the guns, working in connection with the production of the material of war, are quite as necessary as the actual fighting forces in the prosecution of the nation's greatest undertaking. The United States Civil Service Commission, whose duty it is to recruit the civilian forces, announces that the War and Navy Departments are badly in need of large numbers of technically trained men. The commission urges, as a patriotic duty, that qualified persons offer their services to the Government at this time of great need. Among the positions now open are the following:

	Usual Entrance Salary
Automotive engineer	$2,400 to $7,200 a year
Automotive designer	1,800 to 3,000 a year
Automotive draftsman	1,400 to 2,000 a year
Automotive tracer	1,000 to 1,400 a year
Expert in motor-vehicle standardization	1,600 to 3,000 a year
Mechanical engineer	3,500 a year
Junior mechanical engineer on high-pressure apparatus	1,600 to 2,400 a year
Mechanic experienced on high-pressure apparatus	3.00 to 5.00 a day
Inspector of mechanical equipment	2,700 a year
Inspector of structural steel	2,400 a year
Inspector of laundry machinery	1,800 a year
Operative in gas manufacture	1,600 to 2,400 a year
Assistant operative in gas manufacture	3.00 to 5.00 a day
Superintendent of high-explosive and acid plant	1,500 to 1,800 a year
Marine-engine and boiler draftsman	3.28 to 7.04 a day
Metal-furniture draftsman	4.00 to 6.00 a day
Engineering draftsman	3.04 to 7.04 a day
Mechanical draftsman	4.00 to 8.00 a day
Apprentice draftsman	480 a year
Refrigerating engineer	3,000 a year

A further long list of technical positions in the War, Navy and other departments are to be filled. For the positions named applicants are not required to report at any place for examination, but are rated upon their education, training and experience, and in some cases on work submitted with the application. Physical ability is also considered in some instances. Ratings are arrived at from information set out in the application blank and from corroborative evidence.

The Civil Service Commission calls particular attention to the fact that all necessary information concerning civil-service positions, and application blanks therefor, may be obtained free of any cost by applying to the commission's representative at the post office in any important city, or by addressing the United States Civil Service Commission, Washington, D. C. Many of the drafting positions are open to women.

Will Tie-In Three Electric Companies

At a recent meeting of the representatives of the Pacific Gas and Electric Co., the Northern California Power Co. and the California-Oregon Power Co. and the members of the California Railroad Commission, at Sacramento, Calif., the details were completed for the "tie-in" of the three companies to effect a full utilization of the hydro-electric facilities of Northern California. As a result, the three companies will immediately start construction on transmission lines to connect up the systems of their respective companies at a total cost of $640,000.

The California-Oregon Power Co. will connect its system up with that of the Northern California Power Co. by reconstructing its transmission line from the plant at Copeo to Castella and by building a 70,000-volt transmission line from Castello to Kennet, a distance of 90 miles. The estimated cost of this work is placed at $330,000. The Northern California Power Co. is to reinforce its lines from Colman to Hamilton, a distance of 80 miles, by the addition of copper conductor of sufficient capacity to handle a load of 8000 kw. throughout the year. The work to be done by the Pacific Gas and Electric Co. includes the construction of a 60,000-volt transmission line from Colusa Corners, near Colusa, to Drum-Cordella, a distance of 40 miles, and the installation at their substation of from 60,000 to 100,000 volts capacity to deliver power into that line.

The entire project is to be completed by Sept. 1, according to the present plans, and it is estimated that as soon as the surplus power from the northern part of the state becomes available the load taken from the steam-generating plants will be such as to effect an economy in the use of fuel oil to the extent of 240,000 bbl. per year.

As soon as the "tie-in" is effected, the Pacific Gas and Electric Co. will be required to reroute power from certain of its existing plants over Wise-Stockton-Mission-San José line to the southern district now served by the company.

Steam and Water Packing and Rubber for Chile

Consul John R. Bradley states in *Commerce Reports* that the American consulate at Punta Arenas, Chile, is desirous of being supplied with catalogs of steam and water packing, sheet rubber and sheet asbestos. There is quite a large demand there for all kinds of packing. This is the home port for some 20 small steamers plying in the coasting trade, besides which there are five meat freezing and packing plants, several sawmills, an electric-light plant, and a canning works; also a coal mine. The purchasing agents in most cases understand English, and catalogs may be furnished in that language. To prevent delay in making these firms acquainted with American products a list of users of steam and water packing and sheet rubber in Punta Arenas, to whom catalogs should be sent direct, may be procured from the Bureau of Foreign and Domestic Commerce or its district and coöperative offices upon referring to file No. 99693.

Use of Bran for Fuel in Argentina

According to the *Commerce Reports* one milling company in Argentina at present has a daily production of about 280 tons of bran, but there is practically no local market for it as stock food, and it cannot be exported because of the lack of shipping. Nearly all of it is used for fuel. The company itself burns about 100 tons per day, and this replaces some 60 tons of coal, which was formerly used. According to Mr. J. Buelinckx, general manager of the company, bran gives about the same result as wood. The remainder of the output of this establishment—about 180 tons a day—is sold to various concerns for fuel. The present price is 28 pesos per metric ton, and this is somewhat cheaper than wood. The company is experimenting in making briquets of bran, but as yet has not commenced their manufacture upon a large scale.

The Future of Water and Steam Power

The following is from lectures prepared by Prof. L. P. Breckenridge as part of his fuel-conservation work for the Fuel Administration.

The development of water power in this country will be gradual. Our coal supplies are vast, and we shall use coal for power production. We shall need 50,000,000 hp. by the year 1930, and of this amount, one-fifth should be water power, or 10,000,000 hp., leaving 40,000,000 hp. to be made by burning coal. This power is probably in excess of our total available potential water power. The writer believes that we might increase our production of power by 12,000,000 hp. without the consumption of any additional coal. To accomplish this, we should expect to assign to water power a development of 4,000,000 hp. This would leave 8,000,000 hp. to be developed by burning coal. It would mean the adoption of more economical equipment on the one hand and more economical methods of procedure and operation on the other.

From a chart, "Power Development in the United States," the following figures were taken:

POWER DEVELOPMENT IN THE UNITED STATES

Year	Millions of Horsepower		
	Water	Steam	Gas
1870	1.10	1.35	...
1880	1.12	2.40	...
1890	1.25	5.00	...
1900	2.20	14.00	0.4
1910	5.25	23.50	
1920*	(9.00)	(33.00)	

* Extended.

While it is not possible to determine with great accuracy figures such as given, it is sufficient to indicate the fact that the total power development in the United States is very great, and that the percentage of the total power now being developed from water fortunately is increasing.

As an indication of present tendencies, it may be well to mention a few of the more important water-power developments that have been completed within recent years, including also the installations at Niagara Falls:

Power Companies at Niagara Falls	Installation, Horsepower
On American side:	
Hydraulic Power Co., of Niagara Falls	144,000
Niagara Falls Power Co	118,300
On Canadian side:	
Ontario Power Co., of Niagara Falls, Ontario	120,000
Canadian Niagara Power Co	62,500
Electrical Development Co., of Ontario (limited)	52,000
International Railway Co	3,000
Total	499,800

The "Salmon River," N. Y., 30,000 hp., under 235-ft. head.
The "Tallulah Falls," Ga., 70,000 hp., under 580-ft. head.
The "Ocoee River," Tenn., one of 27,000 hp., under 110-ft. head, and another 30,000 hp., under 272-ft. head.
The "McCall Ferry," Susquehanna River, ultimate capacity 135,000 hp.
The "Coons River," 13 miles above Minneapolis, 3500 hp. under 17½-ft. head. "Keokuk," Iowa, Mississippi River, present 120,000 hp., ultimate capacity 300,000 hp. under 20-39-ft. head.
The "Pitt River," Mt. Shasta, Redding, Calif., ultimate capacity 200,000 hp., under 939-ft. head.
The "Klamath River," Thrall, Calif., present 10,000 hp., ultimate 53,000 hp. Head not given.
"Big Creek," P. L. and P. Co. to Los Angeles, present 60,000 hp., ultimate 400,000 hp., 1900-ft. head, 15,000 volts, 241 miles transmission.

The price at which power is sold to the consumer depends upon several important factors: (a) The cost of producing the power, (b) the cost of distributing, (c) the amount purchased by the consumer, (d) the amount available at any one time for the consumer, (e) the time at which the power must be used, (f) the extent of coöperation between the producers and users of power, (g) the cost of administration.

At Niagara Falls large quantities of power are sold at $20 per hp. per year, which is about 0.3c. per kw.-hr. This power is sold near the falls, and the distributing cost is therefore small.

In Toronto, 90 miles from Niagara Falls, the city buys large blocks of power at $18.50 per hp. and sells 10-hour power at $28.

In Norway, where the great air-nitrate industries consume large amounts of power, the price is said to range from $1.90 to $12 per hp. per year.

In this country steam-generated power is made and sold at prices ranging from $30 to $150 hp. per year for 10-hour power. If the plant capacity is 1000 hp. or over, the cost of power need not be more than $25, with the price of coal at $4. The cost will, of course, increase for the smaller plants, but may be as low as $15 for larger plants (3000 hp.) and coal at $2 a ton.

Test Electric Welding for Ships

A report of the purposes and possible benefits of the ship-welding test now being conducted by the Emergency Fleet Corporation at the Federal Shipbuilding Co. plant at Newark, N. J., under the direction of Arthur J. Mason, has been made to Charles Piez, vice president of the corporation.

The text of Mr. Mason's report follows in part:

Electric welding in its various phases has for years been employed in shipyards and in the arts generally, but for a number of reasons the work has been confined to odd jobs and repairs and the test itself will take the form of building part of a hull at the Federal Shipbuilding Co.'s plant, Newark.

It has been necessary to design a ship to suit the material available, without encroaching on that needed for the regular ship construction at the plant. This has been done. The hull will have the outline, dimensions and strength conforming to the ships the Federal company is building.

Briefly, the program is to assemble a hull rapidly by spot welding, tacking the ship together. After the material is thus assembled and fastened with spot welds, so that it is sufficiently strong to hold its shape, the work is completed by arc welding all seams to insure strength and render the work water-tight. Roughly, the spot welds are expected to be about 10 in. apart.

Electric welding offers a great field for lightening a ship. In this design various views of this opportunity will be tried out. The field here is very great—ultimately 10 per cent. of the steel may be eliminated.

The manufacture of the spot-welding yoke and appliances is placed in the hands of the Universal Electric Welding Co. of Long Island City. The design of the yoke is completed, the patterns are made and steel castings will be forthcoming in a few days. The early stages of the arc welding are to be accomplished by the Wilson Electric Co., which was so successful in the work on the German ships' repairs, but it is the intention to call in all men with ideas and apparatus and to give them a field to test out in actual work. To this end Professor Adams' committee is searching out all available talent.

An adequate system of testing the work when done is under consideration. The primary test will consist of filling the hull with water and shifting the points of support under continual and close scrutiny, as one-quarter of the whole will be riveted in the normal manner. There will be always a gage of comparison with that portion which is welded.

Likewise there will be a chance for comparison of the two forms when subjected to abuse by bumping with rams and in various other ways.

Queer Notion of Factor of Safety

On a recent trip to a remote part of the state, one of the boiler inspectors of the Industrial Accident Commission found an installation which was, to say the least, unique. The boiler was of the vertical tubular type, 30 in. in diameter, and was fitted with a ball-and-lever safety valve. In addition to the ball weight, the lever carried four large-sized horseshoes. Upon inquiry it developed that the operator of the boiler thought he had a factor of safety of 5, since he carried only 40 lb. pressure, and the steam gage was graduated to 200 lb. Any idea that the horseshoes were a symbol of good luck, was soon dispelled by the inspector, who pointed out the grave danger of "loading" the safety valve.—*California Safety News.*

According to Mr. Knudsen, manager of Burmeister & Wain, builders of Diesel motors in Copenhagen, fish oil will make an excellent fuel for Diesel engines used as prime movers. Further, this oil will be practicable for small fishing boats where explosion-type motors are used for motive power. It is interesting to note that experiments have already been made, using fish oil as fuel in fishing-boat engines, and that these experiments have proved successful. —*Commerce Reports.*

Heating Values of Fuels

The following tables are from lectures prepared by Prof. L. P. Breckenridge as part of his fuel conservation work for the Fuel Administration.

TABLE I. RELATIVE HEATING VALUE OF WOOD AND COAL

Kind of Wood	Weight per Cord in lb.	Heating Value B.t.u. per lb.	Equivalent Weight of Coal of 13,500 B.t.u
Ash	3520	5450	1420
Beech	3250	5400	1300
Birch	2880	5580	1190
Cherry	3140	5420	1260
Chestnut	2350	5400	940
Elm	2350	5400	940
Hemlock	1220	6410	580
Hickory	4500	5400	1800
Maple, hard	3310	5460	1340
Oak, live	3850	5460	1560
Oak, white	3850	5400	1540
Oak, red	3310	5460	1340
Pine, white	1920	6830	970
Pine, yellow	2130	6660	1050
Poplar	2130	6660	1050
Spruce	1920	6830	970
Walnut	3310	5460	1340
Willow	1920	6830	970

TABLE II. APPROXIMATE HEATING VALUES OF DIFFERENT COALS

Fuel	Heating Values B.t.u. per Pound
Wood (dry)	(varies)
Peat (air-dried)	5,500–7,500
Lignite	about 7,500
Bituminous coal	5,200–7,500
Anthracite	9,500–14,500
Straw	11,500–14,000
Corn	about 5,100
Tanbark (dry)	7,200–8,200
Hydrogen	about 6,100
Crude oil	62,000
Kerosene	17,500–21,000
Gasoline	0.863 sp.g.–18,700
Natural gas	0.710 sp.g.–18,500
Producer gas	About 850 per cu.ft.
Blast-furnace gas	About 125 per cu.ft.
	About 95 per cu.ft.

Constants for Heat Transmission

B.t.u. transmitted per square foot per hour per degree difference in temperature between inside and outside air are as follows:

CONSTANTS FOR BRICK WORK

4 in. thick = 0.68	16 in. thick = 0.27	28 in. thick = 0.18
8 in. thick = 0.46	20 in. thick = 0.23	32 in. thick = 0.16
12 in. thick = 0.33	24 in. thick = 0.20	36 in. thick = 0.15

MISCELLANEOUS CONSTANTS

Reinforced concrete, 20 per cent. more than brick. Add one-third more for stone. Add one-half more for cement or concrete walls.

1 sq.ft. of wood as flooring	0.083	1 single skylight	1.118
1 sq.ft. of wood as ceiling	0.104	1 double window	0.560
1 sq.ft. of wood as wall	0.220	1 double skylight	0.621
1 sq.ft. fireproof flooring	0.124	1 door	0.420
1 sq.ft. fireproof ceiling	0.145	Cor. iron wall	0.840
1 sq.ft. cement as flooring	0.310	Wood wall	0.280
1 sq.ft. dirt as flooring	0.230	Copper, silver-plated and polished	0.02657
1 sq.ft. wood, under slate, or composition roof	0.300	Copper, polished	0.03270
1 sq.ft. wood, under iron	0.170	Zinc and brass, polished	0.04906
1 sq.ft. tile (no bds.underneath)	1.250	Sheet iron	0.08585
1 sq.ft. cement roof	0.600	Cast iron, new	0.6480
1 single window	1.090	Cast iron, rusted	0.6868
1 single monitor	0.950	Oil or varnish	1.4800

The amount in square feet of each kind of surface is to be multiplied by its respective constant shown, and by the difference in temperature between inside and outside air. The sum gives the loss of heat in B.t.u. by exposure then add to the foregoing as follows:

Ten per cent. for northern exposure and where the winds are to be counted on as an important factor.

Ten per cent. if heated day time only, and the location of the building is not exposed.

Twenty per cent. when the building is heated day time only, and the location of the building is exposed.

Thirty per cent. when the building is heated during winter months intermittently with long intervals of non-heating. —*From the "Ideal Fitter," compiled from well-known authorities.*

When the engineer's requisitions are not honored in full, it is time to get a new chief or a new man in the supply department. Trust a man or fire him.—*Marine Engineering.*

A Good Suggestion for All

Do you ride all the bumps or bumpers of the war news from day to day? Many good patriots do. Each morning brings its passing changes in the war situation; now gloom in the form of a setback on the western front, or further disintegration in Russia, or rumors of delay in our own war preparations. Next morning, like as not, there will be something of a hopeful nature, such as the checking of the Huns' drive in Italy, or a raid by the British or French, or good news here at home. To follow and feel all these glees and glooms from day to day is human and exciting. But it involves much useless wear and tear of the spirit. There is another viewpoint—that of disregarding the daily shifts and changes in the war situation, keeping one's attention concentrated on the long haul of war and the final result.

That haul is still a long one. For Germany is not beaten yet, but the results are sure, because we have right on our side, and also the largest battalions. If you grow warm and then cold, and alternate between enthusiasm and depression with the daily news changes, you not only waste your energy, but are likely to fluctuate in your policy as a business man and your determination as a patriot. The good resolution to save food, support Uncle Sam financially and cheerfully, adjust your business and habits to the war program will be stiffened on the morning that you read about some Hun atrocity against our own soldiers in France. But in a week there may be news of a different character, which leads you to let down a little, on the assumption that Germany has begun to crack and that the war is about over. It is good business, good patriotism and good conservation to forget most of the headlines in the morning paper and concentrate strictly upon the long, hard grind between today and the final result. That will save your spirit, buck up your resolution and enable you to do your utmost in winning the war.

Moreover, it will enable you to get out of the war, as a business man and a patriot, the utmost benefit from war adjustments. Those adjustments make for wiser and more economical personal habits, as well as a business grounded in sound economy. Even should peace come tomorrow, you can never go back to the old heedless wasteful ways either in business or livelihood. Don't ride the bumps of the war news!

Settle down in harness for the long grim haul that counts. —*James H. Collins, Editor "Weekly Bulletin."*

Modern Towers of Babel

One of the distinct hazards in employment in this country rests on the coworking of men of different nationalities who do not understand the language of one another, and the question has been frequently raised in the courts as to when an employer becomes liable for injury to one of his workmen caused by negligence of another who has not become "acclimated" to our language.

Very recently this question was presented to the New York Court of Appeals in the case of Barber vs. Smeallie, 117 Northeastern Reporter, 611, where a non-English speaking employee started a pump while a coemployee was known to him to be in a perilous position, resulting in injury to the latter. The injured man, in suing his employer, sought to fix liability under the rule of law that an employer is responsible for injuries inflicted by a fellow employee who was previously known to be so incompetent for the work assigned to him as to make the employer guilty of negligence in retaining him to the peril of other workmen. But the court, reversing judgment which had been awarded in the injured man's favor, decided that a worker cannot be said to be incompetent merely because he does not understand English, and that the employer cannot be held in such instances unless there was a direct and natural connection between his unfamiliarity with English and the accident. This unfamiliarity could not be said to be the cause of the accident in this case; the direct cause was mental deficiency of the negligent man, apart from his linguistic ignorance, and it was not claimed that the employer previously knew of that deficiency.

Personals

J. C. Halvey has resigned his position as master mechanic with the A. H. Crist Co., Cooperstown, N. Y., to accept a position with the Air Nitrates Corporation, and after spending some time studying the processes at Niagara Falls, he will proceed to Muscle Shoals, Ala.

Frederick D. Herbert, who has for years been identified with the marine industry and for the last ten years New York manager of the Terry Steam Turbine Co., has been elected president and general manager of the Kearfott Engineering Co., Inc. He will continue to handle the marine work of the Terry Steam Turbine Co., at 95 Liberty St., New York, which is the office of the Kearfott Engineering Co., Inc.

J. A. Kinkead, who has been the New York representative of the Parkesburgh (Penn.) Iron Co. for the past ten years, leaves shortly to locate in San Francisco to look after the interests of the same company and also the Chicago Railway Equipment Co. there. On finishing his course in the University of Illinois, Mr. Kinkead was employed as chief inspector of material for the Northwestern Railroad and later had general charge of the inspection of material for the American Locomotive Co. He is a well-known member of many technical and engineering societies and clubs.

Engineering Affairs

The Pennsylvania State Association of the N. A. S. E. will hold its annual convention at Chester, Penn., June 20, 21. Indications point to a successful meeting.

The Canadian Association of Stationary Engineers will hold its twenty-ninth annual convention at London, Ont., June 25-27. The meetings of the delegates and the display of the exhibitors will be held at Hymen's Hall, Queens Ave. and Clarence St. A hustling local committee assisted by G. C. Keith, Secretary of the Exhibitors' Association, are completing final arrangements.

The National District Heating Association will not hold its regular convention this year, but the executive committee, together with the chairmen of the standing committees, and as many members as possible, have decided to meet at the Breakers Hotel, Cedar Point, Ohio, July 8-9, to discuss various matters now affecting the heating companies and to receive reports of the standing committees for the year.

Miscellaneous News

Production of Coal was somewhat curtailed in the Charleston, (W. Va.) section last week, operators of the mines claiming that a part of the loss of production was due to the failure of the Logan Power Co. to furnish sufficient current to them.

United States Fuel Administrator Garfield announced recently the appointment of John P. White, Labor Advisor to the Administration, as the representative of the Administration on the Labor Policy, of which Felix Frankfurter is chairman. It is the task of the Labor Policy Board to find out what the needs of labor are so that a labor budget can be made. The Government departments having industrial-service bureaus independent of each other have given rise to some confusion and waste, variations in wages leading workmen to leave one job for another. In one sense the Labor Policy Board will constitute a centralized employment agency for the United States.

Business Items

The H. W. Johns-Manville Co's. Houston (Tex.) office will be located at 424-426 Washington Ave. on and after July 1.

The Colonial Supply Co., Pittsburgh, Penn., because of its increasing business has purchased and moved into the building at 217 Water Street.

The A. Gulowsen A/S of Christiania, Norway, manufacturers of the "Grei" heavy oil engine, has incorporated the Gulowsen Grei Engine Co. at Seattle, Wash., and is erecting a large factory where these engines will be manufactured for supplying the American trade.

The Crane Packing Co.'s New Yory City office has moved to larger quarters in the Park Row Building, with Julian N. Walton as manager. A. W. Payne, for some time manager of this district, has been made sales manager or the United States and Canada, with headquarters at the home office in Chicago. The Pittsburgh offices are located in the May Building, the Philadelphia office in the Colonial Trust Building.

The Reeves Engineering Co., Trenton, N. J., has been incorporated to act in the capacity of constructing and efficiency engineers and to specialize in the design and construction of power and industrial plants. The business and assets of the Reeves-Cubberly Engine Co., Trenton, N. J., have been absorbed by the Reeves Engineering Co., which will continue the manufacture of the Reeves steam and gas engines.

Parr Terminals Co., Wilfred N. Ball, Engineer, 225 First National Bank, Oakland, Calif., wants catalogs and other data from manufacturers of materials or equipment used in the construction of piers, warehouses, industrial buildings, belt line railway and street work and cargo handling equipment; coal bunkering and handling equipment; floating drydock and marine railway equipment; general shipyard machinery and equipment.

Peerless No. 4810 Air Hose was used in a remarkable record at driving rivets made under handicap at the Morse Dry Dock and Repair Co.'s plant in South Brooklyn recently. Bertram Bieher, riveter, and his holder-on, Eddie Hesse, with four heater boys, drove 1480 regulation-size ¾-in. button-head rivets in 4 hours and 10 minutes. For a record of this kind it is obvious that air hose plays an important part in rivet driving. It would not do to have to stop to make repairs.

Trade Catalogs

Monthly Stock List of Cutters.—The Cleveland Milling Machine Co., Cleveland, Ohio. Pp. 36; 3½ x 6 in.; illustrated.

The Stoker for the Higher Volatile Coals. Laclede-Christy Clay Products Co., St. Louis, Mo. Pp. 12; 8½ x 11 in.; illustrated.

Buffalo Forges. Buffalo Forge Co., Buffalo, N. Y. Pp. 111; 5 x 7½ in. Illustrating and describing complete line of portable and stationary forges.

Coxe Stoker. Combustion Engineering Corp., New York City. Bulletin C1. Pp. 29; 6 x 9 in. Showing the application of the traveling grate idea. Copy free on request.

Zelnicker's Bulletins. Nos. 241 and 243. Walter A. Zelnicker Supply Co., St. Louis, Mo. Listing bargains in rails, cars, locomotives, general power-plant equipment and machinery.

Link-Belt Silent Chain. Link-Belt Co., Chicago, Ill. Book No. 312. Pp. 40; 6 x 9 in. Giving illustrations and reasons why the silent chain drive is the most efficient transmission for operating machine tools.

Pulverized Coal Equipment. Lehigh Car, Wheel and Axle Works, Catasauqua, Penn. Catalog No. 71. Pp. 28; 8 x 10½ in. Descriptions and illustrations of various units used for the production of pulverized coal attractively presented.

Skinner Automatic Engines. Skinner Engine Co., Erie, Penn. Pp. 47; 8½ x 11¼ in. An attractive illustrated catalog devoted entirely to the exposition of single-valve center- and side-crank Skinner engines, in single-cylinder type from 50 to 600 hp.

Light for the Clothing Industry. Edison Lamp Works of the General Electric Co., Harrison, N. J. Bulletin No. 43,410 contains the latest information on the correct methods of lighting industrial plants. It is well illustrated, showing various lighting schemes most suitable for industrial purposes.

Wheeler-Balcke Cooling Towers. Wheeler Condenser and Engineering Co., Carteret, N. J. Bulletin 109-B. Pp. 28. Shows Wheeler-Balcke cooling towers of numerous designs in capacities varying from a few thousand gallons per hour to nearly a million gallons per hour. It is shown better, in some cases, to combine natural and forced draft. Two pages are devoted to Wheeler-Barnard forced draft cooling towers, which are at times found preferable to the Wheeler-Balcke. Wherever sufficient ground area is available, however, the Wheeler-Balcke is usually considered by consulting engineers as the standard natural-draft tower.

NEW CONSTRUCTION

Proposed Work

9.

Me., Waterville—The Lockwood Co. is having plans prepared by I. W. Jones, Arch., Milton, N. H., for the erection of a new hydroelectric power plant here.

Mass., Boston—The Bureau of Yards & Docks, Navy Dept., Wash., D. C., has received low bids for improvements to its power plant at the Navy Yard, here, from Rideout, Chandler & Joyce, 178 High St., $31,000 (180 days); W. G. Cornell Co., 923 12th St., Wash., D. C., $35,884 (100 days); Lynch & Woodward, 287 Atlantic Ave., $37,764 (100 days).

Mass., Wellesley—Wellesley College is having plans prepared by French & Hubbard, Engrs., 88 Pearl St., Boston, for the erection of a 35 x 45 ft. addition to the boiler house here.

Conn., Danielson—The Goodyear Cotton Mills, Inc., plans to build a brick power house and install steam turbine engines. Estimated cost, $100,000.

N. Y., Auburn—The Empire Gas and Electric Co. plans to issue $1,717,000 bonds; the proceeds will be used to improve and extend its system. H. S. Coleman, Geneva, Gen. Mgr.

N. Y., Buffalo—The Buffalo General Electric Co., 206 Electric Bldg., has had plans prepared for the erection of a 1-story, 95 x 106 ft. sub station addition to its plant. Estimated cost, $17,000.

N. Y., Ossining—The Commission of New Prisons, Hall of Records, New York City, will receive bids for the erection of 5 buildings at Sing Sing; heat and power systems will be installed underground in tunnel. Machinery includes two 400 hp. boilers, piping, 25 hp. motors, etc.

N. Y., Otisco—The Otisco Light and Power Co. has petitioned the Public Service Commission for authority to build and operate an electric lighting plant.

N. Y., Warsaw—The Warsaw Elevator Co. has had plans prepared for repairs to its 1-story power house. C. E. Ketchum, Pres.

N. J., Newark—The Board of Education will soon award the contract for the installation of heating and power in the proposed Hawkins St. School.

N. J. Ogdensburg—The Wharton Steel Co. plans to rebuild its boiler plant at the limestone quarry which was recently destroyed by fire.

Penn., Enola—The Pennsylvania R. R. plans to improve and alter its power plant and engine house here. A. C. Shand, Broad St. Station, Philadelphia, Ch. Engr.

Penn., Meadville—The Northwestern Electric Service Co. plans to build an electric transmission line from here to Kearsage. A. E. Rickards, Commerce Bldg., Erie, Mgr.

Penn., Philadelphia—The Mifflin Chemical Corporation, Delaware and Tasker St., has had plans prepared for the erection of an addition to its boiler plant.

Wash., D. C.—The Bureau of Yards & Docks, Navy Dept., Wash., D. C., has received low bids for the construction of an electric duct system between the Navy Yard, here and the Capitol Power plant at Garfield Park (a) work complete (b) work complete according to bidder's plans and specifications, from N. W. Ryan, New York City. (a) $14,904 (60 days); G. M. Gest, 1330 Woolworth Bldg., New York City (a) $16,500 (75 days); F. S. Smith, 612 14th St., (a) $28,643 (60 days).

Wash., D. C.—The Bureau of Yards and Docks, Navy Dept., plans to build a power house at St. Juliens Creek, Va.; Specification No. 3072. Estimated cost, $7500.

Va., Norfolk—The Bureau of Yards and Docks, Navy Dept., Wash., D. C., will soon award the contract for the installation of an electric lighting and power system in shipbuilding slip No. 1. Estimated cost, $15,000. Noted May 28.

W. Va., Mannington—The Rachel Coal Co. plans to rebuild its power house, ventilation system, etc., at its mine.

N. C., Henderson—The Henderson Box and Lumber Co. plans to install a 150 hp. boiler, engines and a 150 kw. direct connected generator.

Tenn., Ripley—The Ripley Oil Mills is in the market for a second-hand 20 x 42 in. left-hand, rope-drive Corliss engine and also a 75 hp. crude-oil engine.

Tenn., Rockwood—The Public Light and Power Co., Chattanooga, plans to rebuild transmission line from here to Lenoir City. W. R. Stern, Winchester, Mgr.

Tenn., Spring City—Dayton Light and Power Co. plans to build transmission line from here to Dayton.

Ky., Fulton—A. S. Baldwin, Chief Engr. of Illinois Central R. R., 135 East 11th St., Chicago, will soon award the contract for the erection of various units here, including a 40 x 150 ft. boiler house; two 150 hp. boilers, one 85 ft. electric turntable, etc., will be installed. Total cost, $225,000.

Ky., Whitesburg—The Elkhorn Superior Block Coal Co. has increased its capital stock from $35,000 to $100,000; the proceeds will be used to install new electrical machinery.

Ohio, Canton—The Canton Gas and Electric Co. has petitioned the State Public Utilities Commission for authority to build a high tension transmission line along the right of way of the Chicago, Burlington and Quincy R. R.

Ohio, Cleveland—The National Woolen Co. is having plans prepared by A. Gairing, Arch., for the erection of a 2-story power plant. H. W. Stecher, 3131 West 83rd St., Pres.

Ohio, Creeksville—The Central Power Co. plans to build a transmission line from here to Bearfield Twp. E. T. Wagenhals, Newark, Supt.

Ohio, Fremont—The City Council is considering the installation of a gas and electric lighting plant to be erected here.

Ohio, Norwood—City will sell bonds for improvements and extensions to its electric lighting and water works systems. W. R. Suhr, Auditor.

Mich., Homer—The Homer Electric Light and Power Co. plans to build additions to its plant. G. H. Rising, Engr.

Ill., Amboy—A. S. Baldwin, Chief Engr., of the Illinois Central R. R., 135 East 11th St., Chicago, will soon award the contract for the erection of various units here, including a 40 x 150 ft. boiler house, etc.; two 150 hp. boilers, one 85 ft. electric turntable, etc., will be installed. Total cost, $250,000.

Ill., Carbondale—A. S. Baldwin, Chief Engr. of Illinois Central R. R., 135 East 11th St., Chicago, will soon award the contract for the erection of various units here, including a 40 x 150 ft. boiler house, two 150 hp. boilers, one 85 ft. electric turntable, etc., will be installed. Total cost, $250,000.

Ill., Jacksonville—City plans to vote on bond issue to build a dam, control station, etc. About $75,000. S. Greeley, 64 West Randolph St., Chicago, Engr.

Ill., Mounds—A. S. Baldwin, Chief Engr. of the Illinois Central R. R., 135 East 11th St., Chicago, will soon award the contract for the erection of various units including an addition to the boiler house; two 150 hp. boilers, one 85 ft. electric turntable, etc., will be installed. Total cost, $250,000.

Wis., Wausau—City plans to establish a central lighting and heating plant here.

Iowa, Neola—City plans to improve its electric lighting and power plant. Estimated cost, $16,000.

Iowa, Sioux City—The Midland Packing Co. plans to build a boiler and power plant in connection with its proposed packing plant. Gardner & Lindberg, 140 South Dearborn St., Chicago, Engr.

Minn., St. Paul—The Northern Pacific Mutual Beneficial Association is having plans prepared for the erection of a hospital and power plant. Total cost, $300,000. H. S. Smith, 203 Railroad Bldg., Pres. L. Bassindale, Capital Bank Bldg., Arch.

S. D., Bradley—Dakota Northern Power Co. plans to build a power station. E. H. Lewis, Secy.

Mo., Maysville—City has plans under consideration for improvements to its electric lighting plant.

Okla., Miami—The Luck Jenny Mining Co. will build a concentration plant at its mine in Hockerville. Equipment including engines, boilers, etc., will be installed. Estimated cost, $60,000. W. F. Cooper,, Supt.

Utah, Salt Lake City—Salt Lake Co. will soon award the contract for the installation of a heating system in the courthouse. S. G. Clark, Clerk.

Nev., Palisade—The Union Mines Co. plans to install a large quantity of electric machinery in its proposed concentrating plant.

Ariz., Kingman—The Schuylkill Mining Co. plans to install a power plant in connection with its milling plant now under construction.

Ariz., Phoenix—The State Hospital for the Insane has had plans prepared for the erection of a power house. Noted Apr. 16.

Wash., Bellingham—The Boundary Red Mountain Mine plans to rebuild its power plant which was recently destroyed by fire.

Calif., Lompoc—The Lompoc Light and Power Co. plans to improve its plant and distribution system. Estimated cost, between $5000 and $10,000. A. H. Wishon, Fresno, Mgr.

Calif., Los Angeles—The California Edison Co. has been granted a franchise by the Board of Supervisors, for the erection and maintenance of an electric distributing system in Los Angeles County.

Sask., Lloydminster—W. and E. Johnson plan to build an electric lighting plant. Estimated cost, $60,000.

CONTRACTS AWARDED

R. I., Lonsdale—The Lonsdale Co. has awarded the contract for the erection of a transformer station, to The J. W. Bishop Co., 109 Foster St., Worcester, Mass.

N. Y., Albany—H. A. Biggs, Commissioner of Health, has awarded the contract for the installation of a heating system to the Merrill Co., 19 Pearl St., Boston, Mass., $45,082; the electric lighting system, to Gagen & Butler, Inc., 1402 Bway., New York City, $10,484. Noted Apr. 9.

N. J., Jersey City—The Elks Club Association has awarded the contract for the installation of lighting and power for its building on Hudson Blvd., to L. Fort, 428 Hoboken Ave. Estimated cost, $9000.

Ohio, Columbus—The Smith Agricultural Chemical Co., Champion and Leonard Sts., has awarded the contract for the erection of an addition to its power house, to the Frankenburg Constr. Co., 705 Columbus Business Savings and Trust Bldg.

Ohio, North Canton—The Hoover Station Sweeper Co., c/o H. W. Hoover, has awarded the contract for the erection of a 1-story, 40 x 50 ft. addition to its boiler house, to Custer Bros., 141 Smith Ave., N. W. Canton. Estimated cost, $8000.

Mich., Cheboygan—The Cheboygan Electric Light and Power Co. has awarded the contract for the erection of a new power house at the Black River dam, to W. Moody, Cheboygan.

Mich., Detroit—The D. Stott Flour Mills Co., Warren and Grand River Ave., has awarded the contract for the erection of a 1-story, 35 x 50 ft. boiler house, to the Wisconsin Bridge and Iron Co., 1362 Penobscot Bldg. Estimated cost, $10,000.

THE COAL MARKET

Boston—Current quotations per gross ton delivered alongside Boston points as compared with a year ago are as follows:

ANTHRACITE

	Circular Current	Individual Current
Buckwheat	$4.60	$7.10—7.35
Rice	4.10	6.65—6.90
Boiler	3.90	.....
Barley	3.60	6.15—6.40

BITUMINOUS

Bituminous not on market.

Pocohontas and New River, f.o.b. Hampton Roads, is $4, as compared with $2.85—2.00 a year ago.

*All-rail to Boston is $2.60. †Water coal.

New York—Current quotations per gross ton f.o.b. Tidewater at the lower ports* are as follows:

ANTHRACITE

	Circular Current	Individual Current
Pea	$4.90	$5.65
Buckwheat	4.45@5.15	4.80@5.50
Barley	3.40@3.65	3.80@4.50
Rice	3.90@4.10	3.00@4.00
Boiler	3.65@3.90	.....

Quotations at the upper ports are about 5c. higher.

BITUMINOUS

	F.o.b. N. Y. Gross	Mine Price Net	Gross
Central Pennsylvania	$5.06	$3.05	$3.41
Maryland—			
Mine-run	4.84	2.85	3.19
Prepared	5.06	5.05	3.41
Screenings	4.50	2.55	2.85

*The lower ports are: Elizabethport, Port Johnson, Port Reading, Perth Amboy and South Amboy. The upper ports are: Port Liberty, Hoboken, Weehawken, Edgewater or Cliffside and Guttenberg. St. George is in between and sometimes a special boat rate is made. Some bituminous is shipped from Port Liberty. The ratte to the upper ports is 5c. higher than to the lower ports.

Philadelphia—Prices per gross ton f.o.b. cars at mines for line shipment and f.o.b. Port Richmond for tide shipment are as follows:

	Line		Tide	
	Current	One Yr. Ago	Current	One Yr. Ago
Pea	$3.45	$3.00	$4.35	$3.90
Barley	2.15	1.50	2.40	1.75
Buckwheat	3.15	2.50	3.75	3.40
Rice	2.65	2.00	3.65	3.00
Boiler	2.45	1.80	3.55	2.90

Chicago—Steam coal prices f.o.b. mines:

Illinois Coals	Southern Illinois	Northern Illinois
Prepared sizes	$2.55—2.70	$3.25—3.40
Mine-run	2.35—2.50	3.00—3.15
Screenings	2.05—2.20	2.75—2.90

St. Louis—Prices per net ton f.o.b. mines are as follows:

	Williamson and Franklin Counties	Mt. Olive & Staunton	Standard
6-in. lump	$2.55-2.90	$2.55-2.70	$2.55-2.70
2-in. lump	2.55-2.90	2.55-2.70	2.55-2.70
Steam egg	.....	.....	2.20-2.40
Mine-run	.....	2.35-2.50	2.00-2.20
No. 1 nut	2.55-2.90	2.55-2.70	.....
2-in. screen	2.05-2.20	2.05-2.20	.....
No. 5 washed	2.05-2.20	2.05-2.20	.....

Birmingham—Current prices per net ton f.o.b. mines are as follows:

	Mine-Run	Lump & Nut	Slack and Screenings
Big Seam	$1.90	$2.15	$1.65
Pratt, Jagger, Corona	2.15	2.40	1.90
Black Creek, Cahaba	2.40	2.65	2.15

Government figures.

Individual prices are the company circulars at which coal is sold to regular customers irrespective of market conditions. Circular prices are generally the same at the same periods of the year and are fixed according to a regular schedule.